THE

SEVENTH ANNUAL REPORT

FROM

THE GOVERNORS

OF THE

MADRAS UNIVERSITY,

1847-48.

MADRAS:

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1848.

MADRAS UNIVERSITY.

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Governors.

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Second do ....MR H. BOWERS,
Third Tutor....MR. J. McLEISH,
Fourth do ....MR. T B. PEPPIN

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GUNNESH GUNGADER SASTRY..... *Mahratta Pandit.*
VIZAGAPERMAUL IYER ..... *Tamil do.*
STREENASSA RAGAVACHERY..... *Do. Asst. do.*
P. CHINNIAH SOOREE..... *Teloogoo do*
HYAGREEVA SASTRY..... *Do Asst. do.*

SEVENTH ANNUAL REPORT OF THE PRESIDENT AND GOVERNORS OF THE MADRAS UNIVERSITY.

To

The Right Honorable the
GOVERNOR IN COUNCIL,
Fort Saint George.

RIGHT HONORABLE SIR,

1. We, the President and Governors of the Madras University, have the honor to submit to the consideration of Government our Seventh Annual Report of the state and progress of the Institution under our charge.

2. In obedience to the directions of Government, communicated in the Minutes of Consultation, No. 129, dated 5th February, 1847, we still, as in our last Report of 3d July, 1847, confine our attention to that department of the Institution which alone has as yet been established,—namely, the High School.

3. It seems proper, however, to notice that since our last Report we have been furnished by Government with an Extract of a letter from the Honorable Court of Directors, in which the Court desire that our Board "should enlarge the sphere of its operations," and should, as part of a general body, superintend the University, in common with all other educational Institutions. The Court, in the same letter, have also issued their instructions for some change in the general standard for test qualifications in Candidates for Government employment.

4. Although these instructions supply a more extensive subject for our Board's communications with Government, in reference to the general education of the people; yet, as the superintendence of the University is a distinct matter, required, by its fundamental rules, to be reported upon separately, and as Government has not yet organized a general body or

Council of Public Instruction, comprising Members of our Board, with a view to more enlarged operations,—we have considered ourselves bound to attend to the express and still existing commands of Government, by confining our present Report to the condition and prospects of the High School only, and by refraining from any notice of the original and more comprehensive design of the Institution as an University.

5. We have much satisfaction in reporting favourably of the progress of the High School in fulfilling the original objects of its establishment. Perhaps the *best* proof of it, is that regularity in carrying out the system laid down, and in its corresponding results, which precludes any novelty in details. That system is exhibited at large in the first Annual Report, and its results may be witnessed at the Annual Public Examinations, when all classes of the School are scrutinously tested in their attainments.

6. The high quality of those displayed by the fourth class might possibly suggest a suspicion in those, who may not have watched the progress of scholars throughout the gradation of classes, that their attainments are superficial and hastily acquired. Such suspicions would not fail to be dispelled by an adequate acquaintance with the exercises pursued in the lower classes. It would be found, that their elementary knowledge, in Grammar, Geography, Arithmetic, &c., is as exact, as the superior quality of literature and science is critical and well sustained in the highest class. No scholar can move from one class to another, till he has earned, at the stated period of promotion, his position in the upper section of it, and acquired the portion of instruction appropriated to that class. The Board, as well as the Masters, would deem it equally a deviation from the rules laid down, as a failure in the object of them, if the scholars did not fully understand the subjects in which they offered themselves for examination.

7. On the present Anniversary, seven have attained the distinction of " Proficients," and will receive that degree, publicly conferred upon them, from the Governor's hands. Two of them have entitled themselves to that degree in the

first scale of " honors," namely, Sashiah and Ramanoojum; and Chengannah to a Second Class Degree. The other four have entitled themselves to a common degree, without special honor; but as three of them desire to remain another year before receiving their degrees, that degree will, on this occasion, be conferred only on the scholar about to leave. It may be to the purpose to mention the course of instruction these youths have passed through, without noticing their exercises in the lower Classes of the School.

8. Their attainments comprise an acquaintance with the Histories of Rome and Greece, through Goldsmith, and the Histories published by the Society for the Diffusion of Useful Knowledge, and with the help of Niebuhr:—the History of Modern Europe, through Russell;—the History of India, through Symonds, Norton, and Marshman,—and the Philosophy of History, through Smyth's Lectures. In Natural Philosophy, they have studied Plane Astronomy, through Herschell;—Optics, from the work of the Society for the Diffusion of Useful Knowledge, and from notes and formulæ of the Head Master, Mr. Powell. Mechanics, Hydrostatics, and Pneumatics from the same materials, and Chemistry from Mrs. Marcet's work. They have studied the elements of Political Economy, from Mrs. Marcet's work; and Mental Philosophy, from Abercrombie's work on the Intellectual Powers. Their attainments in Mathematics include the whole of Euclid, Plane and Spherical Trigonometry, the three first sections of Newton's Principia, as modelled by the Head Master, and the Ellipse in Conic Sections. To these studies are to be added, copious readings in Shakspeare, Milton, Pope, and the Extracts from various authors published in Chambers' Encyclopœdia of Literature, and the Calcutta Reader. Their proficiency in English Composition, as well as in some of the sciences above enumerated, will best be judged of on reference to the Appendix to be published with this Report. Further, it is due to Ramanoojum, to call the attention of Government, and of the public, to his precalculation of the late Solar Eclipse, without a minute's appreciable error, which

the Supreme Government has expressed a desire should be published, with a view to do this youth honor, and for which this Government has conferred the reward of a present of books.

9. The number of Scholars has gradually, though slowly, increased from the time of the School's first opening. The number at the close of the last Report (which was dated 3d July, 1847,) was 157. It is now 170. We have no doubt of the increasing and extensive popularity of the Institution, under the fostering patronage of Government. Distinction in the School, and the attainment of the proficient's degree, can hardly fail to be an object of ambition to youths of the higher orders of the Native community, when they see that every proficient has obtained a considerable appointment in the service of Government or of the Public, and one of them the distinguished post of Head Interpreter to the Supreme Court at an early period of life. At the same time, the Board are induced rather to encourage the aim of the Scholars (especially such as have fair means) at distinction in the independent walks of life, in which their enlightened education would ensure them success, and probably raise their social rank much higher than can be looked for through official employment. Whether as regards these aims in professional and mercantile life, or in the service of Government and the Public, the Board again submit their opinion, that the establishment of some Collegiate Classes, according to the original design of the Institution, such as in Medicine, in Engineering, and in Jurisprudence and Local Law, would greatly conduce to these desirable results.

10. One other most material source of prosperity to the Institution we are also disposed on this occasion to recur to, —namely, the erection of a structure suitable to the objects of the Institution, and upon a plan admitting of such gradual extension as its successful progress may suggest.

11. The Board have upon several previous occasions urged this measure on the consideration of Government, and, so far back as the 18th August, 1844, the Honorable Court express-

ed themselves as follows upon its expediency. "You have "requested our instructions regarding the expediency of erect- "ing a suitable building, with apartments for the Head Mas- "ter, for the accommodation of the Institution, as urged by "the Governors, not only on the grounds of convenience, but "because the commencement of the work will have a power- "ful effect in attracting public confidence, and giving stability "and popularity to the Establishment. A building erected "expressly for the use of the School will, no doubt, be more "convenient, and will bear a more public character than any "accommodations held at a monthly rent; but it is desirable "that you should be fully satisfied as to the probable perma- "nence of the Institution, before you incur the expenditure "necessary to erect suitable buildings." Government, in paying just attention to this condition, inculcated by the Honorable Court, must have become long ago fully convinced of the permanent stability of the Institution; for, on 22d June, 1847, it was communicated to the Board, in answer to their further representation of the expediency of this measure, that Government "would request the attention of the Honor- "able Court to the suggestion of the President and Governors "of the University for the erection of a suitable building for "the purposes of the Institution, at a cost not exceeding "50,000 Rupees. His Lordship in Council concurs with the "President and Governors in opinion that the plan of the "building should be such as to admit of extension at a future "period, and the situation to be as central as possible."

12. To this communication from Government to the Honorable Court we are not aware of the reply; but we are led from the former language of the Court to presume its entire sanction of the step, as soon as Government should be satisfied of the stability of the Institution. As every year adds to the conviction of that stability,—which alone could have led to the recommendation by Government more than a year ago,—we encourage the hope that Government will now be disposed to concede the measure which we have felt it our duty so pressingly to advocate.

13. We are desirous of introducing an improved system of Vernacular Instruction, both as regards the quality of tuition, and an increase in the number of Native Teachers. A scheme for this object is still under the consideration of the Board, and will in due course be laid before Government. It will necessarily occasion an addition to the monthly expenditure of 175 Rupees at present, and eventually of 405 Rupees. Trusting that we shall satisfy Government of the reality of the improvement contemplated, and of the important public benefit resulting from the cultivation of the Vernacular languages, with a view to their refinement and better efficiency, particularly in prose,—we feel assured of Government's accustomed liberality in giving effect to measures so peculiarly within the province of the Institution.

14. Of the recent Annual Examinations we desire to say no more than the Appendix of the Scholars' Exercises will testify. But we have again to bring to the notice of Government the difficulty which exists in procuring examiners. We have in a former Report (the 5th) explained the cause of this difficulty, and we still venture to advocate the expediency of appointing *paid* examiners, who,—upon a moderate remuneration accommodated to their actual services,—might officiate as well in examining the Candidates for public employment, as at the Annual Public Examination of the Scholars of the High School. Since the duties of the late Council of Education have been transferred to our Board, we have had under our consideration the revision of the Test rules for the general examination of Candidates for public employment, so as to make them conformable to those acted upon at Bengal, and with the most recent instructions of the Honorable Court of Directors on the subject. In submitting them, as we trust at an early date, we shall advert again to the topic of procuring efficient public examiners.

15. On the recent examination of the School, we had only the benefit of the assistance, as voluntary examiners, of Mr. J. B. Norton (one of our Governors), and Madava Row (a first Class Proficient), the latter examining in the higher depart-

ments of Mathematics. The chief burden of conducting the examinations fell upon Mr. Gordon, the second Master, in the absence of the Head Master, Mr. Powell. We desire to record our thanks to these Gentlemen; and the Board are induced to notice the peculiar mastery of his subjects exhibited by Madava Row, and the talent with which he elicited from the Scholars the knowledge they possessed. The Board desire further to express their thanks to the Government examiners, who conducted the examinations in the Vernaculars, Mr. C. P. Brown, Mr. Davidson, and Major Crisp.

16. One of our Governors (Mr. J. B. Norton) having desired to present the most distinguished Scholar in optics with the present of a valuable Microscope, our Board, in accepting this liberal donation, allowed it to be competed for by an Essay on the nature and use of this instrument by the Scholars of the Fourth Class. The prize was awarded to Ramanoojum, and our Board have sanctioned the reading of his Essay at the celebration of the Anniversary.

17. In conclusion, the Board have to record their entire satisfaction with the performance of their duties by the Masters, Tutors, and Teachers. The Head Master, Mr. Powell, was compelled in January last to resort to a sea voyage for the recovery of his health. His duties have been undertaken by the extra labour of Mr. Gordon, the second Master, with the valuable assistance of Madava Row in Mathematics. The pay for these duties has been deducted from the salary of the Head Master, so that no extra expense has been occasioned to Government. These duties have been so well fulfilled that not a single Scholar who aimed at his degree at the ensuing Anniversary has been disappointed, and the promotions in the School have not been materially retarded. But with whatever ability these officiating Masters have performed their tasks, it could not be expected that the want of Mr. Powell's well proved services should not be felt. It is, however, no longer necessary that the Board should testify their high estimation of them. We have recorded our sense of this Gentleman's qualifications, his talents and his exertions, in

our second Report: our further experience does but confirm the sentiments we then expressed.

We have the honor to be,
Right Honorable Sir,
Your very obedient Servants,

(Signed) GEORGE NORTON, *President*,
„ J. WYLIE,
„ C. RUNGANADUM,
„ JOHN BRUCE NORTON,
„ L. VENCATAPUTTY NAIDOO,
„ K. NURSINGA ROW,
„ C. STREENEVASSA PILLAY.

APPENDIX.

Scheme of Studies pursued by the Scholars of the High School of the Madras University, during the year 1847-48.

English Department.

Subjects	Books	Portions read during the year.	Portions for examination
	4th Class, Upper Rank.		
Mental Philosophy	Abercrombie on the Intellectual Powers	The whole	The whole.
Philosophy of History	Smyth's Lectures on Modern History	The whole of Volume 1	The Introductory Lecture, and Lectures I II IV V VI VII IX & X
Plane Astronomy	Herschel's Treatise	The first 8 Chapters, and the calculation of Eclipses and Transits	The whole.
Physical Astronomy	Newton's Principia	The first 3 Sections	The whole
	4th Class, Lower Rank.		
History	Russell's Modern Europe	Vol 3, Part 3, Letters 1, 2, 3, 4, 5, 6, 7, 8	Letters 1, 2, 4, 5, 6
	Goldsmith's History of England	The whole	The whole
English Literature	Shakspeare	Julius Cæsar and some select portions	Julius Cæsar.
	Bacon's Essays	The whole	The whole.
Political Economy	Marcet's Conversations on Political Economy	The whole	The whole
Natural Philosophy	Outlines of Optics with additional calculations	The whole	The whole
Mathematics	Snowball's Trigonometry	Spherical Trigonometry	The whole.
	Hamilton's Conic Sections	The Ellipse	The whole
	3d Class, Upper Rank.		
Grammar	Murray's large Grammar	Syntax, and the Appendix, 3 Chapters	The whole
Geography	Guy's Geography, and Symonds' Geography of India	Guy, from page 81 to page 94; Symonds' from Chap 7 to the end of the work.	The whole learnt out of Symonds' work
Poetry	Calcutta Poetical Reader, No. 3	Various portions selected.	
History	Goldsmith's History of England	From James 1, to George 2	From the Commonwealth to George 2d
Political Government	Norton's Rudimentals	3d and 5th Discourses	The whole
Arithmetic	Bonnycastle's Arithmetic	From Fractions to Discount	The whole
Algebra	Pinnock's Catechism of Algebra	1st Mathematical Division as far as Simple and Quadratic Equations	Two Quadratic Equations.
Euclid	Williams' Symbolical Euclid	1st Mathematical Division 4 Books	2d and 3d Books.

Subjects.	Books.	Portions read during the year.	Portions for examination.
Trigonometry....	Snowball's Trigonometry	2d Mathematical Division: Plane Trigonometry....	The whole.
Chemistry.....	Marcet's Chemistry.....	2d Mathematical Division: 5 Conversations.....	The whole.
Natural Philosophy.....	Introduction to Natural Philosophy.....	Hydrostatics, Pneumatics and Optics.....	Pneumatics.
	3d Class, Lower Rank.		
Grammar.....	Murray's large Grammar	The whole of Syntax with the notes.....	The whole.
Geography.....	Guy's Geography and Symonds' Geography of India.....	Guy from page 81 to page 94: Symonds' from Chap. 24 to Chap. 20 and Chap. 7, 8, and 9.	The Chapters on India in Symonds' work.
Poetry.....	Calcutta Poetical Reader, No. 3.....	From page 54 to page 83	
History.....	Goldsmith's History of England.....	From the reign of James 1, to that of George 2d.	From the Commonwealth to George 2d.
Arithmetic.....	Bonnycastle's Arithmetic.	From Decimal Fractions to Equation of Payments	The whole.
Algebra.....	Pinnock's Catechism of Algebra.....	1st Division: from the beginning to Involution 1st Part.....	The whole.
		2d Division: from the beginning to Quadratic Equations 1st and 2d Part.....	Quadratic Equations.
Euclid.....	Williams' Symbolical Euclid.....	1st Division: 2 Books.....	1st Book
		2d do. 4 do.	2d and 3d Books.
Astronomy.....	Introduction to Natural Philosophy.....	3 Sections of Astronomy..	The whole.
	2d Class, Upper Rank.		
Roman History..	Goldsmith's Abridgment..	From Chap. 17th to 23d ..	Chap. 22 from the reign of Augustus to that of Domitian.
EnglishGrammar	Murray's Abridgment....	The whole.....	The whole.
Arithmetic.....	Bonnycastle's Arithmetic.	Simple and Compound Proportion, Vulgar and Decimal Fractions.	Vulgar and Decimal Fractions
Geography.....	Hogarth's Exercises.....	The whole...	North and South America.
Spelling.....	Carpenter's Assistant.....	From page 68 to page 83.	
Poetry.....	Gay's Fables.....	From Fable 1st to 24th, Part 1, and Fables 1, 2, 3, Part 2.....	Fables 4th, 6th and 16th
	2d Class, Lower Rank.		
Roman History..	Goldsmith's Abridgment..	From Chap. 1st to 12th....	From Chap. I. to VIII.
EnglishGrammar	Murray's Abridgment....	From Orthography to Syntax.....	Syntax
Arithmetic.....	Bonnycastle's Arithmetic.	Rule of Three, Single.....	Rule of Three, Single.
Geography.....	Hogarth's Exercises.....	The whole.....	Europe and Asia
Spelling.....	Carpenter's Assistant	From p. 51 to p 80.....	From "S." p. 74, to "A." p. 80.
Poetry.....	Gay's Fables.....	From Fable 1st to 16th, Part 1st.....	Fables 4, 6 and 16.

Subjects.	Books	Portions read during the year	Portions for examination.
	1st Class, Upper Rank.		
English Grammar	Murray's Abridgment....	The whole twice gone over.....	Syntax and Parsing
Arithmetic.....	From the Master	As far as the Rule of Three	Rule of Three
Geography.....	Hogarth's Exercises	The whole twice gone over	Europe and Asia
Spelling	Carpenter's Assistant ...	From "I J." p. 63, to "L" p 78.....	From "R" p 72, to "L" p 78
Reading Poetry	Poetical Reader, No II ..	From Fable 2 to 24 inclusive...	Fables 14, 15, 17 19 and 22
„ Prose ..	Goldsmith's Natural History.....	From Chap 25, p 270, to the end.	Chapters 29, 31, 32, 33, 34, 38.
	1st Class, Lower Rank.		
Grammar..	Murray's Abridgment....	Etymology and Syntax, twice each	Syntax and Parsing
Arithmetic.....	From the Master.....	Compound Rules....	Compound Addition and Subtraction.
Geography.....	Hogarth's Exercises.....	The whole twice.....	Africa and America
Reading	Goldsmith's Natural History..... ...	From Chap 22 to Chap 28, and from Chap 32 to 38	From Chap 25 to 28, and from Chap 33 to 35
Spelling	Carpenter's Assistant	From page 1 to 12.....	From page 1 to 12
Poetry	Gay's Fables....	From Fable 1 to 12	None
	Preparatory Class.		
Reading.... ...	The Fables of Æsop.....	From Table 1 to 82 and twice from 1 to 60	From Fable 1 to 45
Grammar...	Elements of Grammar....	Orthography and Etymology, twice..... ..	Etymology
Geography.... .	Cliff's Geography	Asia twice, Africa twice, and Europe once.....	Africa
Arithmetic.....	From the Master....	Four Simple Rules..	Simple Multiplication.

The scholars in the fourth class practised original composition twice a week, and those in the third class wrote abstracts of portions of their historical studies

Vernacular Department.

Subjects.	Books	Portions read during the year	Portions for examination.
	Tamil, 1st Class.		
Moral Aphorisms	Korul.....	Ten Chapters from the commencement	8 Chapters.
Grammar...	Nunnool..... ...	The whole of "Orthography ".....	50 Rules
	2d Class.		
Grammar	Vena Vedi—Catechism ..	22 pages from the commencement.....	22 pages

Subjects.	Books.	Portions read during the year.	Portions for examination
Fables & Stories.	Robertson's Selections. ..	20 pages from the commencement....	20 pages
	3d Class.		
Moral Lessons...	Neethesaravakeyam.....	20 pages from the beginning.....	20 pages.
	4th Class.		
Stories.....	Kathamunjarie..... ..	50 stories.....	30 stories.
	Beginners' Class.		
First Lessons....	Arechoovady.....	16 pages from the beginning.....	16 pages.
	N. B.—In the month of November an attempt was made to assimilate the system of Vernacular teaching to that pursued in the English Department, in consequence of which, those portions only have been put down which have been read since that time.		
	Telugoo, 1st Class.		
Grammar.....	Gooroomoorty Sastry's Grammar.....	The whole.....	The whole of Section 2.
Fables.....	Arabian Nights.....	300 pages.....	100 pages
History.....	Manucharitra.....	6 pages.....	The whole.
	2d Class.		
Grammar.....	Gooroomoorty Sastry's Grammar	The first 3 sections..	Section 2.
Fables.....	Punchatuntri Fables	50 pages.....	30 pages.
	3d Class.		
Synonymes.....	Andranamasungraham ..	25 pages.....	
Fables.....	Vikramarka Tales.....	113 pages..... ..	From page 93 to 113.
Elementary Lessons....	Balasitcha.....	23 pages.	From page 11 to 22.
	4th Class.		
Elementary Lessons....	Balasitcha..... .	23 pages.....	From page 11 to 22.
Vocabulary.....	Ramakistnah Sastry's Vocabulary.....	40 pages	
Tales.....	Morris' Selections.....	From the 20th Story to 28th	
	Mahratta, 1st Class.		
Grammar.....	Balavyacurna.....	The whole.....	The whole
History.....	Grant Duff's History of the Mahrattas.....	Chapters 29, 30, 31, 32 and 33.....	Chapter 32.
Natural Theology	The Youth's Book on Natural Theology	Conversations 1, 2, and 3..	Conversation 3.
	2d Class.		
Grammar.....	Balavyacurna.....	The whole.....	The whole
History	Catechism of Mahratta History.....	From page 1 to 42..... ...	From page 31 to 42.
Morality..... ..	Nitidurpana	The whole.	

Subjects	Books.	Portions read during the year	Portions for examination
	3d Class, 1st Division.		
Morality	Nitidurpana.....	From page 1 to 47.....	From page 9 to 13.
	Jagathejoth.....	The whole	
	3d Class, 2d Division.		
Morality.....	Jagathejoth.....	From page 1 to 25.....	From page 9 to 13.
	Niti katha	The whole..... ...	
	4th Class, 1st Division.		
Natural History	Natural History.....	From page 1 to 18.....	From page 10 to 16.
Morality.....	Bodhavachan.....	The whole.	
	4th Class, 2d Division.		
Elementary Lessons	Tipidhava.....	From page 1 to 20.....	The whole.

The senior scholars were exercised in translating from English into the Vernaculars, and vice versâ, on Wednesdays and Saturdays

APPENDIX B.

Questions proposed of the Scholars in the Upper Fourth Class.

History.

Q. 1. To what should we more particularly attend in the History of Modern Europe?

2. Explain the scene which offers itself to the historian of Europe in the early centuries of the Christian era.

3. Why is our attention directed to the dark Ages?

4. What induced Pepin to raise the Pope into a temporal prince?

5. In what way may we become acquainted with the manners and customs of those Northern Nations which destroyed the Roman Empire?

6. On what battle-field was the power of the Saxons prostrated; and to what were they as a people particularly attached?

7. What were the great impediments to the improvement of human happiness during the middle ages?

8. Are differences of opinion likely to exist in every mixed form of Government?

9. What impression does one of our popular elections make upon foreigners?

10. What powers were possessed by the Wittenagemots?

11. What circumstances were eventually beneficial to the liberties of England?

12. What circumstances were most unfavourable to the liberties of France?

13. What doctrines did the Reformation eventually establish?

Mental Philosophy.

Q. 1. What opinions were formerly held by writers on the science of mind regarding the origin of our ideas?

2. To what is the origin of our ideas in a philosophical point of view, referable?

3. What do we know of perception?

4. What is reflection?

5. How do we proceed in receiving facts on the evidence of testimony?

6. What is meant by the words credulity and scepticism?

7. May not a cultivated mind perceive the elements of truth in a statement, which is rejected by inferior minds, as altogether incredible?

8. Explain what is meant by the association of ideas.

9. What is imagination?

Newton.

Q. 1. A body is thrown upwards with a velocity of 200 feet, how high will it ascend?

2. A body is thrown down from a height with a velocity of 100 feet, and is found to reach the ground in 4 seconds, what is the height?

3. Knowing that the Sun is the centre of force of our system, prove the first law of Kepler.

4. Find an expression for the linear velocity of a body moving in an Ellipse.

5. Prove that angular velocity varies inversely as the square of the distance.

6. Get a general expression for the mass of a Planet attended by a Satellite, in terms of the Sun's mass.

7. What should be the eccentricity of an Ellipse in order that a Planet, moving in it round a centre of force in the focus, may have its greatest linear velocity equal to twice its least?

8. A body moves in an Ellipse round a centre of force in the centre; find the law of force.

9. Find the diameters of curvature at the extremities of the major and minor axes of an Ellipse.

10. Find the area of an Ellipse.

11. How do you draw a tangent to an Ellipse? and show the correctness of the method.

Questions proposed of the Scholars in the Lower Fourth Class.

Russell's Modern Europe.

Q. 1 What was the character of Louis XV.; and what English Monarch did he resemble?

2. Mention what you know of General Lally.

3. Who succeeded Louis XV. on the throne of France; and by whose instrumentality was he married to an Austrian Princess?

4. What French Minister did the Marquis de Pombal resemble; and what policy did he pursue?

5. In what year, and by what Pope, was the Society of Jesuits dissolved?

6. What led to the war between Great Britain and her American Colonies?

7. What persons distinguished themselves on the side of the Americans?

8. Mention what you know of John Wilkes.

9. What Ministers in the reign of Louis XVI. exhibited an acquaintance with the principles of Political Economy?

10. What General acquired reputation by his able defence of Gibraltar?

Political Economy.

Q. 1. What is the difference between natural and exchangeable value?

2. What settles the price of a commodity when brought to market?

3. What is the origin of rent?

4. What effect has the cultivation of new lands upon the price of food?

5. What advantages have metals over other commodities as media of exchange?

6. Explain the theory of population.

Shakspeare.

Q. 1. Who is the hero of the tragedy, entitled Julius Cæsar; and what is his character as drawn by Shakspeare?

2. In what respect does Cassius differ from Brutus?

3. What is necessary to constitute a drama classical, in the opinion of the critics; and is the one before us entitled to the appellation?

4. By what is the theatrical effect of this play injured?

5. How does Cassius endeavour to win Brutus over to his party?

6. Explain the following passages.

Why man, he doth bestride the narrow world
Like a Colossus; and we petty men

Walk under his huge legs and peep about,
To find ourselves dishonorable graves.

O! you and I have heard our fathers say,
There was a Brutus once, that would have brook'd
The eternal devil to keep his state in Rome,
As easily as a king.

Well Brutus, thou art noble; yet I see,
Thy honorable metal may be wrought
From that it is disposed: therefore 'tis meet
That noble minds keep ever with their likes;
For who so firm that cannot be seduced?
Cæsar doth bear me hard: but he loves Brutus;
If I were Brutus now and he were Cassius,
He should not humour me.

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7. Who is Portia, and what is her character?

8. What is meant by the word *physical* in the following lines:—

Is Brutus sick, and is it physical
To walk unbraced, and suck up the humours
Of the dark morning?

9. How does Antony, in his funeral oration over the body of Cæsar, excite the resentment of the people?

Conic Sections.

1. Find the latus rectum of an Ellipse.

2. Find the Equation to the tangent of an Ellipse.

3. Taking the Equation to an Ellipse, reduce it to that of a parabola.

4. Show that no two conjugate diameters can lie in the same quadrant.

5. Get the Equation to an Ellipse referred to a set of conjugate diameters.

6. Prove that the sum of the squares of any two semi-conjugate diameters is equal to $a^2 + b^2$.

7. Prove that S P $\times$ H P is equal to C D^2.

8. Find an expression for an angle inscribed in a semi-ellipse, and show when it will be the greatest and the least.

9. Take a semi-circle M D C, let C be its centre, B C and A D any

two ordinates; A O=O B—join M C, and let it cut A D in N: required the locus of N.

Optics.

1. What is the object of the Science of Optics?

2. Give the construction of the eye; what purpose do its several lenses serve? why is its inside lined with black; what adaptation is seen in the iris and the pupil?

3. Explain the cause, and give the remedy of those defects in vision, called long and short sight.

4. Investigate all the changes in the size of the image formed by reflection at the surface of a concave mirror.

5. Two concave mirrors, each of one foot radius, are placed in front of each other at the distance of twenty feet; an object is placed at the distance of $\frac{30}{59}$ of a foot from the first mirror. Find the position and size of the image formed by the rays suffering reflection both at the first and second mirrors.

6. Find the formula connecting the conjugate foci of a convex plane lens, without deducing it from the general expression.

7. Describe the Camera Obscura, the refracting telescope, and the compound microscope.

8. Given the focal distances of a number of lenses, find the focal distance of the compound lens, leaving the thickness out of consideration.

Spherical Trigonometry.

1. Show that the sines of angles of a spherical triangle vary as the sines of the opposite sides.

2. What are Napier's rules for the solution of right angled triangles?

3. What place has the parallel of latitude passing through it, equal to half its meridian?

4. Prove that the formulæ called Napier's Analogies are applicable to the case of a triangle where two sides and the included angle are given.

5. If each of the sides of a spherical triangle be a quadrant, and if a, b, c, be the distances of any point within it from the angles, prove that—

$$\text{Cos}^2 a + \text{Cos}^2 b + \text{Cos}^2 c = 1.$$

6. Knowing the angular distances of a Comet from two Stars

whose right ascensions and declinations are known, how do you find its right ascension and declination?

7. Show that the distance between two places on the Earth having the same latitude, measured on a parallel to the Equator, is greater than that measured by a great circle.

8. Given that the longest day at a certain place equals m. times its shortest, how do you determine its latitude?

9. The tangent of the difference of Longitude and R. A. of the Sun $= \frac{1-\text{Cos } o}{1+\text{Cos } o}$, where O=obliquity. Find the Longitude of the Sun.

Questions proposed to the Scholars in the Upper Third Class.

Norton's Rudimentals.

Q. 1. Who first discovered a passage to India by sailing round the Cape of Good Hope?

2. What led to the abandonment of the old routes?

3. In what year, and by what sovereign, was the first Charter granted to the Governor and Company of Merchants of London trading to the East Indies?

4. In what year was the commercial intercourse between England and India established on a permanent basis; and what settlements did the Company at this time possess?

5. What new powers did the Charter of Charles II. confer upon the Company?

6. How came it in the power of Charles II. to confer upon the Company the Island of Bombay?

7. What led to the establishment of a new and rival Company?

8. In what year did the British enter upon that career of conquest, so glorious to themselves, and so beneficial to the Natives?

Calcutta Poetical Reader No. III.

Q. 1. What is the purport of the following lines:

I would not have a slave to till my ground;
To carry me; to fan me while I sleep
And tremble when I wake, for all the wealth
That sinews bought and sold have ever earned.—
No: dear as freedom is, and in my heart's
Just estimation prized above all price,
I had much rather be myself the slave,

And wear the bonds, than fasten them on him.
We have no slaves at home—then why abroad?
And they themselves, once ferried o'er the ocean
That parts us, are emancipate and loosed—
Slaves cannot breath if their lungs
Receive our air, that moment they are free;
They touch our country, and their shackles fall.

1. What is slavery?
2. Why cannot slaves breathe in England?
3. What is the meaning of the words *to till, sinews, bonds, ferried, emancipate, shackles?*
4. In what does a metaphor differ from a simile?
5. What is personification?

Pneumatics.

Q. 1. What is Pneumatics?
2. In what does air differ from other fluids?
3. To what distance does the atmosphere extend, and what is its gravity?
4. What prevents this weight from crushing a man to atoms?
5. Mention some of those experiments which illustrate both the weight and elasticity of the air.
6. What is the instrument called the barometer?
7. When are two fluids said to be in equilibrium?
8. To what height will the pressure of the atmosphere sustain a column of water?
9. Describe the pump.
10. What is wind?
11. Why is there always an East wind at the equator?

Plane Trigonometry.

Q. 1. Find the value of sine 18°.
2. Find *Tan* A. + B. in terms of the separate functions of A. and B.
3. Prove that the sines of angles of a triangle vary as their opposite sides.
4. The two sides and the included angle of a triangle being given, find the other angles directly.
5. Explain fully the ambiguous case in the solution of triangles.
6. Find the area of a triangle in terms of its sides.

7. How do you find the distance between the tops of two inaccessible mountains?

8. Upon ascending 100 feet above the surface of the Earth, I can just see the top of the mast of a Ship: upon ascending 200 feet, I see the whole vessel. How do you measure the height of the Ship?

Heat.

Q. 1. What are the properties of free and latent caloric?

2. What are those instruments which are designed to measure the free and specific heat of a body? Give their construction.

3. What experiments prove that different bodies possess different powers of radiation, and that their capability to absorb heat is proportionate to their power to radiate it?

4. Explain fully the theory of the formation of dew.

5. Explain how it is that evaporation produces cold, and condensation heat. Give one or two remarkable experiments to illustrate this.

6. Explain the principle of the Steam Engine.

7. What improvements did James Watt introduce in the Steam Engine?

Selected Answers of the Scholars of the Upper 4th Class.

Smyth's Lectures on Modern History.

Answer (1.)—It is almost impossible for any one to study modern history in detail, and to attend to all the events that have happened, whether important or unimportant. It is therefore necessary for him to consider and study with care all those events which have materially affected the fates and fortunes of nations. These are, the contest between the barbarians and Romans; the subsequent fall of the Roman Empire; the dark ages that followed; the revival of learning; the reformation; the times of Louis XIV.; the religious wars; and the prosperity of Europe, during the end of the last century.

V. Ramanoojum.

Answer (2.)—The scene that offers itself to the historian of Europe in the early centuries of the Christian era is one of the most appalling nature. Here we see the uncivilized portion of mankind drawn out in array against the civilized swarms of ruthless barba-

rians proceeding from the teeming hive of the north, pouring with impetuosity against the civilized states of Italy. On the one hand, youth and vigour nerve the arm of the barbarian fresh from the hands of nature—while on the other, old age, luxury, and effeminacy enervate the Romans—here simplicity and the sterner virtues of the savage give impetus to the enterprizes of the barbarians—there profligacy, treachery, and dishonesty, the attendant vices of a degenerating nation, accelerate the fall of the Romans. Looking at this awful epoch in another point of view, it is with the greatest concern we behold the sun of civilization sinking down, and a night of barbarism succeeding, whose gloom was worse than Egyptian darkness.

A. Sashiah.

Answer (3.)—Our attention is directed to the dark ages, because these times immediately succeeded the overthrow of the Roman Empire, and contained in them, though in a very obscure state, all the civilization of Rome, and much of the elements of the modern European governments and of the European character.

Answer (4.)—It is the nature of all usurpers to have some one to sanction their unjust usurpations. Some apply to the people—some to foreign potentates, and some to other quarters where they expect assistance. As the Pope was the head of the religion, Pepin who usurped the crown of France thought that his sanction would have much weight among the people, and consequently applied to him to sanction his unjust seizure of the crown, and promised in return the Ex-archate of Ravenna and the Pentapolis. This induced the Pope to side with Pepin and consequently became a temporal prince.

V. Ramanoojum.

Answer (5.)—We have but one accurate way of becoming ourselves acquainted with the manners and customs of the barbarians, and that is through the medium of the codes of laws which were enacted for the guidance of their conduct, as members of a community.

Answer (6.)—The power of the Saxons was prostrated at the battle field of Hastings where Harold II., the Saxon prince, was defeated and slain by the Norman William, surnamed the Conqueror. The Saxons were a people that considered war as their profession, and were attached to Liberty. Piracy likewise was one of their national characteristics.

Answer (7.)—The great impediments to the improvement of human happiness, during the middle ages, were the Papal power and

the Feudal system—the former entailed intellectual slavery and the latter, physical—the one shut out Europe from the light of knowledge—the other excluded the mass of the people from the exercise of those natural privileges, which belong to man as a free born being.

Answer (8.)—Differences of opinion are sure to exist in every mixed form of government, from the very nature of the materials of which it is composed—the Monarch would always be for absolute power—the Aristocracy would ever be trying to confine all authority within their own limited circle—and the Democracy would naturally wish to be supreme. It is in the due balancing of these opposing tendencies that the superiority of a mixed form of government consists.

Answer (9.)—Foreigners who are present at a popular election in England are said to have been so struck with the bustle, the clashing of interests, and the opposing sentiments there freely given out, that they have often imagined that a revolution was at hand, and what is still more wonderful have held correspondence with their friends on the continent, touching the probability of such an occurrence.

Answer (10.)—The Wittenagemote or as the word implies "the assembly of wise men," may be said to have been the present Parliament in its infant state, and was the great council of the nation in the times of the Saxons. They had the judiciary power vested in them—that of investigating and deciding upon cases, and the important privilege of taxing themselves. All topics of national consequence were discussed in their assembly. This assembly was in fact the representatives and the guardians of the nation.

A. Sashiah.

Answer (11.)—In England there were many usurpers, who were obliged to have recourse to the people to seat themselves firmly on the throne. The people, therefore, had many opportunities of extorting privileges from their monarchs; and they took care, also, to have the characters, that gave them the privileges, renewed from time to time, until the principles of liberty were deeply impressed upon the minds of the people, and the privileges, were too firmly established, to be afterwards shaken by any monarch.

Answer (12.)—France was constantly invaded by England, and infested by banditti. These gave the people no time to think of improving their states-general, or of wresting privileges from their monarchs. They moreover forgot to get the charters that gave them a few privileges, renewed from time to time as was the case in England. France therefore lost her constitution.

Answer (13.)—The Reformation eventually established the doctrines of toleration, and liberty of conscience.

V. RAMANOOJUM.

Mental Philosophy.

Answer (1.)—It was formerly maintained by writers on the science of mind that our ideas were derived entirely from perception, that is from external objects. Others supposed them as arising partly from perception and partly from reflection. There was again a third class of philosophers who considered that there were innate ideas in our mind co-existent with ourselves and prior to and independently of the exercise of perception or reflection.

Answer (2.)—In a philosophical point of view the origin of our ideas is referable to perception and reflection; but the knowledge acquired by an individual through his own senses forms a very small fraction of what he possesses; much of his knowledge is therefore acquired through the perceptions of other men, and is received upon the evidence of testimony.

Answer (3.)—All that we know of perception is that certain impressions made upon the organs of sense, convey to the mind a knowledge of the qualities which belong to external objects.

G. CHENGANNAH.

Answer (4.)—Reflection is that process of the mind by which past perceptions and impressions are compared or contrasted with the present. This appears to be a complex process where reason and memory are called into play.

Answer (5.)—When we receive facts upon the evidence of Testimony, we proceed with more cautious steps than when these facts become the subjects of our immediate observation. Thus we take into consideration the veracity of the narrator—the opportunities he has had of ascertaining the truth—and his disinterestedness in the matter of his narration. Again the accordance of the fact in question with facts known to us already, goes a great way to induce us to believe the offered fact: this accordance is commonly called the probability of an event.

A. SASHIAH.

Answer (6.)—By credulity is meant easiness of belief, and is characteristic of a weak mind, which does not even attempt to rea-

son. Scepticism means doubt, and is the part of a narrow and contracted mind, which reasons upon improper data, and makes its own amount of knowledge, the test of probability.

V. RAMANOOJIAH.

Answer (7.)—Yes ; a cultivated mind may perceive the elements of truth in a statement, which is rejected by inferior minds as incredible ; and in order to prove that it may, an ingenious writer supposes a traveller coming into the country of Archimedes, and describing the Steam Engine. Although the statement is rejected by all as being diametrically opposed to their own experience, still Archimedes pronounces his opinion that the account may be true, merely from his knowledge of the properties of steam.

Answer (8.)—When two or more facts have been contemplated together, they become associated in such a manner that one of them at a future period, never occurs to our mind without being accompanied by the others. This principle is called the association of ideas.

Answer (9.)—Imagination is that process of the mind by which we separate classes of facts or scenes into their constituent elements, and form these elements into new combinations, which have no real existence in nature. Thus by the process of imagination, a painter depicts a landscape, combining all the beauties of nature and excluding all its deformities. In like manner a Poet calls into existence a fictitious character, endows him with those qualities which suit his purpose, and places him in contact with other beings equally imaginary. It is needless for me to give a detailed account of this process of mind when the Poet explains it in such a beautiful manner in the following lines.

" The poet's eye, in a fine frenzy rolling,
Doth glance from heaven to earth, and from earth to heaven ;
And as imagination bodies forth the forms of things unknown,
The Poet's pen turns them to shapes, and gives to airy nothing
A local habitation and a name."

G. CHENGANNAH.

Newton.

Answer (1.)—The proposition is to find the space through which the body should move vertically to have its original velocity of 200 feet

per second counterbalanced by the force of gravity—or in other words it is to find the space through which the body should fall from rest to acquire a velocity of 200 feet owing to gravity alone. We know that:

$$V^2 = 2\,sf.$$

where = velocity, s = space, and f the force or gravity. In this equation V is known which is equal to 32.

$$\therefore 40{,}000 = S \times 2 \times 32 = S \times 64$$

$$S = \frac{40{,}000}{64} = 625 \text{ feet the answer.}$$

A. (4.)

$$V^2 = 2\,sf$$

$$\text{but } S = \frac{C}{4}$$

$$\therefore V^2 = \frac{C}{2}.f$$

$$= \frac{CD^2}{AC}\frac{m}{SP^2}$$

$$= \frac{HP.SP.}{AC}\frac{m}{SP^2}$$

$$= \frac{m}{SP}.\frac{HP}{AC}$$

A. (8.)—The law of force for any curve is:

$$F = \frac{2h^2}{SP^2}.L\frac{QR}{QT^2}$$

Therefore to find the law of force in an Ellipse the centre of force being at the centre of the Ellipse we have merely to substitute for $L\frac{QR}{QT^2}$

$$L\frac{QR}{QT^2} = \text{L}\frac{PX}{QT^2}$$

$$= \text{L}\frac{\frac{CP^2}{CD^2}\cdot QX^2.\frac{1}{XG}}{\frac{PF^2}{CP^2}.QX^2}$$

$$= \text{L}\frac{CP^4.QX^2}{PF^2.CD^2.QX^2.XG}$$

$$= \mathrm{L}\,\frac{CP^4 . QX^2}{AC^2 BC^2 QX^2 XG}$$

$$= \frac{CP^3}{2\,AC^4 BC^4}$$

$$\mathrm{F} = \frac{2h^2}{SP^2} \cdot \frac{CP^3}{AC^2 BC^2}$$

$$= \frac{h^2 . CP}{AC^2 BC^2}$$

V. RAMANOOJUM.

Selected Answers of the Scholars of the Lower Fourth Class.

Russell's Modern Europe.

Answer (1)—Louis XV. like Charles II. of England indulged himself in gross amorous gratifications and was too frequently governed by his female companions. Of this the countess Du Barri is a conspicuous instance, by whose advice he expelled from his Court his most beloved minister Choiseul. In his love of pleasure, the calls of duty had very little weight with him, and what the people expected from him as their sovereign were entirely neglected. He was not devoid of good sense and judgment; but he had not the spirit to follow up the dictates of his own mind. He was frequently led into acts of folly and tyranny, which disgusted and incensed the people by whom he was once beloved. This occasioned violent commotions in many of the provinces, and spirited oppositions from the parliament, which though they did not affect him, poured their collected vengeance upon his grandson and his family.

A. (2.)—General Lally was the son of an Irish emigrant officer. He was entrusted by the French East India Company with the command of their forces in India, and displayed in his military career such great and shining abilities, that had he not been baffled by the superior talents of Sir Eyre Coote, he would have well repaid the trust reposed in him. By his influence over the parliament, Choiseul who bore great enmity to the general, procured a sentence against him, not for any specific offence but upon a general charge of misdemeanor in his administration in India. His opponents testified the littleness of their hearts by gagging him at the place of execution, that he might not plead his innocence or inveigh against them.

A. (3.) Louis XVI. succeeded his grandfather Louis XV. on the throne of France, and was married to Maria Antoinette, an Austrian princess, by the instrumentality of Choiseul, who wanted to secure his influence by bringing about a connexion between the two houses.

A. (4.)—The Marquis de Pombal resembled the French Minister the Cardinal de Richelieu, both being possessed of great abilities, but at the same time intriguing, haughty, obstinate, and irreconcilable to their enemies. The course of policy he pursued was to lessen the influence which England exercised over Portugal and which he thought degraded the latter country into the state of an English province.

A. (5.)—The Pope Ganganelli or Clement XIV. seeing the universal odium in which the Jesuits were held for their pernicious principles and intriguing character, and being strongly desired by the Court of France and Spain, issued a bull for the dissolution of that Society about the year 1773.

A. (6.)—Neither guided by justice nor by policy, and forgetting that the characteristic principle, thè safeguard of the British constitution is that no person can be taxed without his being represented in the Parliament ; the British Ministry imposed stamp duties upon the Colonies, which provoked them into immediate resistance, without paying any regard to the prophetic warnings of many of the members of the opposition, and ashamed to acknowledge their faults, they continued to enforce it by coercion. The Americans met them force to force, and thus was brought about the war which deprived Great Britain of half her empire.

A. (7.)—In the American revolution the principal persons that distinguished themselves on the side of the Americans were Washington, the greatest hero and the greatest statesman, Franklin whose eloquence inflamed the spirit of his countrymen, Generals Green, Gates, and Montgomery inferiors in command, and Adams and Hancock the principal members in the Congress.

A. (8.)—John Wilkes, a person of obscure birth, possessed of some talents, but of great perseverance, started forth in the reign of George III. declaring himself as the champion of public liberty, but in reality with a view of profiting by the embarrassments of the Cabinet and the agitations of the times. Being refused the Governorship of Canada, he began to edit a newspaper called the *North Briton*, in which he most bitterly attacked the ministry, and declared that one

of the speeches of the King contained a most infamous falsehood. Upon this a general warrant was issued against the authors, printers, and publishers of the paper, and Wilkes was apprehended. He appealed to the Court of Common Pleas, and was released, being member for Aylesbury in the House of Commons. Thence forward he gave rise to a series of discussions which harassed the Ministry and which it will be tedious to relate here. Suffice it to say while the populace were deluded into a belief that he was the champion of their liberties, even those enlightened persons who despised him for his low character could not but support his cause, for it involved a question, the legality of general warrants which affected the interests of the nation.

A. (9.) Turgot and Necker were the principal Ministers in the reign of Louis XVI. who in the performance of their financial duties testified an acquaintance with the principles of political economy, by abolishing monopolies, and by giving unbounded freedom to trade.

A. (10.) General Elliott distinguished himself by his able defence of Gibraltar against the combined forces of Spain and France amounting to 40,000, supported by a powerful fleet, and nine floating batteries most strongly and artfully constructed.

C. RUNGACHARRY.

Political Economy.

A. (1.) The natural value of a commodity consists of rent, wages, and profit; that is, of the cost of its production. But the exchangable value is the natural value either augmented or diminished according as there is a greater or less demand for the article in the market.

C. RUNGACHARRY.

A. (2.) The proportion which the supply bears to the demand settles the price of a commodity when brought to market.

G. RAJAGOPAUL.

A. (3.) Rent has its rise in the diversity of the productive powers of the soil. To explain this briefly—in a country, the better lands are first taken into cultivation. But an increase of population occasions an increase of demand for the articles of food which raises their price. Thus the profits of the former increasing, lands of inferior quality will be taken into cultivation. But it is one and the

same thing cultivating these lands with a greater cost of production, and paying a rent to the owners of the better lands and cultivating them with a less cost of production.

C. RUNGACHARRY.

A. (4.) The immediate consequence of bringing new lands under cultivation, is a rise in the rent, which, forming a component part of natural value, increases it. As the price of food can never fall below its natural value, it also increases and the change is permanent.

D. BAUBOO ROW.

A. (5.) The advantages which metals have over other commodities as media of exchange are, that they are the least perishable, that they are susceptible of extreme division; that they occupy a comparatively small space, that they have an intrinsic value, and that, in consequence of all these circumstances, they tend to facilitate commerce.

G. RAJAGOPAUL.

A. (6.) The amount of population depends upon the means of subsistence. It may sometimes exceed this point, but in that case, famine is sure to carry off the overplus. And when the means of subsistence is greater, persons who are naturally fond of domestic enjoyments, will marry soon, and thus population will keep pace with the means of subsistence.

C. RUNGACHARRY.

Shakspeare.

A. (1.) The hero of the tragedy entitled Julius Cæsar, is Marcus Junius Brutus. This illustrious personage is one of the most spotless characters, we meet with, in Roman History. The amiable beauty of this person, his generous feeling and patriotic heroism, his rectitude and well-principled virtue entitle him to a very high rank among his countrymen. The purity of his mind and his conscientious love of justice, made him unfit to be the head of any party in an entirely corrupted state and these very faults proved prejudicial to the conspirators and gave an unfavourable turn to their cause. In his own estimation he sacrificed an inferior to a superior claim, and in acting as he did, he only favoured the cause of liberty, which he so well inherited from his forefathers, and so performed what

had always been considered a Roman duty. His memory was kept alive as long as a spark of public spirit glowed among the Romans, and even to this day, the names of Brutus and liberty go together. In short, no man seems to have cultivated as assiduously as Brutus, whatever he considered right; and never has a doubt been entertained of the purity of his motives in joining the conspiracy against Cæsar, and to quote Shakspeare's words, he was the only one of whom Nature could say, to all the world "this was a man."

G. RAJAHGOPAUL.

A. (2.) Brutus acts altogether upon principle, Cassius partly upon impulse. Brutus does nothing before he has satisfied himself with regard to the propriety of the deed; Cassius does nothing of the kind; it is enough that its execution is necessary. Brutus is a philosopher, Cassius is a partisan. Brutus, therefore, deliberates and spares, Cassius precipitates and denounces; Brutus is, in short, unfit to guide in revolutionary times; and Cassius is better cut for a conspirator, possessing independent volition. To conclude, Brutus is the better instructor, and Cassius the better politician.

A. (4.) The theatrical effect of the play is injured by the partial falling off after the death of Cæsar, there being nothing after it, but the intrinsic character of Brutus and Cassius to engage the audience.

A. (5.) Cassius addresses the affection and pride of Brutus in winning him over to his side.

A. (6.) All great objects strike us with an idea of grandeur and sublimity; hence there is something peculiarly apt in comparing Cæsar to a Colossus; Cassius says Cæsar bestrides the narrow world like a Colossus, and that all the Romans who allowed Cæsar to make slaves of them, walk under his huge legs, and look around for dishonorable graves and drop into them, with disgrace on their heads.

A. (7.) Portia was the daughter of Cato, and the wife of Brutus. Her character is beautifully expressed by her husband, who says "you are my true and honorable wife." She died by swallowing red-hot coals, being impatient of her husband's absence in the east.

A. (8.) Physical means healthy, or good for the constitution.

A. (9.) Antony first erazes the impression from the mind of the people, that Cæsar was ambitious. He then excites their pity, and then rouses their revenge, by drawing the populace to sympathize with him.

D. BAUBOO ROW.

Answer (1.) The equation to the ellipse when the centre is the origin, is,

$$y^2=\frac{b^2}{a^2}\left(a^2-x^2\right)$$

The latus rectum is twice the ordinate for the focus, whose abcissa to the centre is $\pm\ ae$ substituting this x in the equation.

$$\begin{aligned} y^2&=\frac{b^2}{a^2}\left(a^2-a^2e^2\ \right)\\ &=b^2\left(1-e^2\right)\\ &=b^2\left(\frac{b^2}{a^2}\right)\\ &=\frac{b^4}{a^2}\end{aligned}$$

$\therefore\ y=\frac{b^2}{a}=$ the ordinate for the focus

$\therefore$ Latus Rectum $=\frac{2b^2}{a}$

C. Rungacharry.

Answer (2.) Let us take the equation to a secant, and let the two points in which the secant cuts the ellipse be (y', x') and $(y'', x''.)$

Then since the line passes through two points (y', x') and (y'', x'') its equation is,

$$y-y'=\frac{y''-y'}{x''-x'}\left(x-x'\right)\ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

And since the two points are in the ellipse

$$a^2\,y''^2\ +\ b^2\,x''^2\ =\ a^2\,b^2$$

and $a^2\,y'^2\ +\ b^2\,x'^2\ =\ a^2\,b^2$

Subtracting

$$a^2\left(y''^2-y'^2\right)\ +\ b^2\left(x''^2-x'^2\right)=o$$

$$\therefore\ a^2\left(y''+y'\right)\left(y''-y'\right)=-\ b^2\left(x''+x'\right)\left(x''-x'\right)$$

$$\therefore\ \frac{y''-y'}{x''-x'}=-\ \frac{b^2}{a^2}\left(\frac{x''+x'}{y''+y'}\right)$$

substituting this value of $\frac{y''-y'}{x''-x'}$ in Eqn. (1)

$$y-y'=-\ \frac{b^2}{a^2}\left(\frac{x''+x'}{y''+y'}\right)\left(x-x'\right)\ldots\ldots\ldots\ldots\ \text{Eqn. (4)}$$

Now the limit or the final position of the secant is the tangent. Therefore if in Eqn. (4) we make the points (x', y') and (x'', y'')

coincide, it will become an Eqn. to a tangent. Doing this in Eqn. (4.)

$$y - y' = -\frac{b^2}{a^2} \cdot \frac{x'}{y'} (x - x')$$

Or reducing $a^2 y' y' - a^2 y'^2 = -b^2 x' x + b^2 x'^2$

Transforming

$$a^2 y' y + b^2 x' x = a^2 y'^2 + b^2 x'^2$$
$$= a^2 b^2$$

which is the equation to the tangent to an ellipse.

C. RUNGACHARRY.

Optics.

Answer (4.) The formula for the focal distance of rays falling upon a concave mirror is,

$$\frac{1}{v} + \frac{1}{u} = \frac{2}{r}$$

where v, u, and r, are the distances of the focus, the radiant, and the centre from the mirror. Therefore

$$\frac{u}{v} + 1 = \frac{2u}{r}$$

$$\therefore \frac{u}{v} = \frac{2u}{r} - 1 = \frac{2u - r}{r}$$

$$\therefore \frac{object}{image} = \frac{u}{v} = \frac{2u - r}{r}$$

$$= -\frac{r - 2u}{r} \text{ if } r > 2u \therefore \text{ if } u < \frac{r}{2}$$

Now as $\frac{2u - r}{r}$ is + or − the formula divides itself into two cases, in the former the image being real, and in the latter virtual:

Let us take the first case

$$\frac{object}{image} = \frac{2u - r}{r}$$

Here u increases from r to infinity.

When it is equal to r

$$2u - r = r$$
$$\therefore \text{ image} = \text{object.}$$

As u increases, $u - r$ becomes greater and greater than r; and

when u is infinite, it is infinitely great. That is the image diminishes till it becomes infinitely small.

Again

$$\frac{o}{i} = -\frac{r - 2u}{r}$$

where we omit — as that merely shows the image is virtual, and also here,

$$u \angle \frac{r}{2}$$

Let $u = \frac{r}{2}$

Then $r - 2u = o \therefore \frac{r - 2u}{r} = o \therefore \frac{o}{i} = o$

That is the image is infinitely great, since the object remains constant.

Let u diminish

$\therefore r - 2u$ increases

$\therefore \frac{r - 2u}{r}$ increases

$\therefore \frac{o}{i}$ increases

$\therefore$ The image diminishes till u becomes not when $\frac{r - 2u}{r} = 1$

$\therefore \frac{o}{i} = 1$

That is image = object

Hence in real images.

When the object is at the centre, the image which is also there is equal to it, as it is removed from it, the image diminishes, till it is placed at an infinite distance, when it is infinitely small. As it is brought nearer and nearer the mirror than the centre, the image becomes greater and greater, till it is placed at the focus when it is infinitely great.

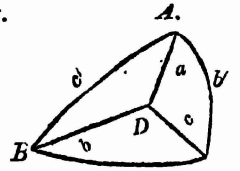
Again in virtual images.

The image is infinitely great when the object is in the focus, and as it is brought nearer and nearer, the mirror, the image diminishes, till it is brought to the mirror when the image is equal to it.

RUNGACHARRY.

Spherical Trigonometry.

A. (5.) Let ABC be a △ such that AB, BC, and AC are each =90°. Take any point D within △. Join AD, BD, and CD; and let AD=a, BD=b and CD=c.



$$\cos A = \frac{\cos a' - \cos b' \cos c'}{\sin b' \sin c'} = 0 = \cos 90^\circ$$

$$\therefore A = 90^\circ$$

Similarly B and C each $= 90^\circ$

In the quadrantal △ ABD taking complement of a, as the middle part, and that of b, and the ∠ ABD as the opposite parts.

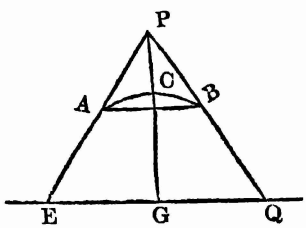
$$\text{Cos } a = \text{Sin } b.\ \text{Cos ABD}$$
$$\therefore \text{Cos}^2 a = \text{Sin}^2 b.\ \text{Cos}^2 \text{ABD}$$
$$\text{Similarly Cos } c = \text{Sin } b.\ \text{Cos DBC}$$
$$= \text{Sin } b.\ \text{Sin ABD}$$
$$\therefore \text{Cos}^2 c = \text{Sin}^2 b.\ \text{Sin}^2 \text{ABD}$$
$$\therefore \text{Cos}^2 a + \text{Cos}^2 c = \text{Sin}^2 b.\ (\text{Cos}^2 \text{ABD} + \text{Sin}^2 \text{ABD})$$
$$= \text{Sin}^2 b.$$
$$= 1 - \text{Cos}^2 b.$$
$$\therefore \text{Cos}^2 a + \text{Cos}^2 b + \text{Cos}^2 c = 1.$$

C. Rungacharry.

Answer (6.) Let A, B, be the two stars, and C the comet, G Q the equator, and P the pole.

Draw PAE a meridian through APBQ through B and PCG through C. Join CB, CA and AB.

In △ APB, AP = co-declination of A, PB of B and the ∠ P= the difference of right ascensions of A and B.



∴ AB is known; and PAB is known in △ ACB, AC, CB, and AB are known.

∴ CAB is known.

PAC = PAB — CAB and is therefore known.

In △ PAC, PA, AC, and PAC are known.

∴ PC and APC are known.

But PC is the codeclination of C and ABC the excess of the right ascension of C over that of A.

∴ The declination and right ascension of C are known.

C. Rungacharry.

Selected Answers of the Scholars of the Upper Third Class.

Norton's Rudimentals.

Answer (1.) The Portuguese under Vasgo De Gama, were the first who discovered a passage to India by sailing round the Cape of Good Hope, towards the end of the 15th Century.

Answer (2.) The comparative cheapness, facility and certainty of this new route round the Cape of Good Hope led to the abandonment of the ancient course of traffic carried on partly by Syria and the Persian Gulf and partly through Egypt and the Red Sea.

Answer (3.) The first Charter granted by Elizabeth to the "Governor and Company of Merchants of London trading to the East Indies" was dated the 31st December, 1600.

Answer (4.) The commercial intercourse between England and India was in the year 1661 established on a permanent basis. At this time the Company possessed no less than 8 Settlements, viz.: Surat, Cambay, Ahmedabad, Gogo, Calicut, Fort St. George, Hooghly, and Masulipatam. These Settlements were governed by two Boards, each consisting of a President and Council. One of these Boards was established in Surat and the other at Fort St. George. Under that of Surat were placed, Cambay, Ahmedabad, Gogo, and Calicut; and under Fort St. George, Hooghly and Masulipatam.

Answer (5.) The Charter of Charles II. after confirming all former privileges, granted to the Company by the preceding Monarchs, proceeds in clothing the Company with still greater powers than the former Charters had done. By the Charter of Charles II. in 1661, the Company were enabled to levy Military and Naval forces, to make war or peace with the surrounding States; to appoint Governors to govern the plantations, forts, and factories, which they then possessed; to fortify all those places within the limits of their trade. This was in fact empowering the Company to found and govern colonies in whatever parts of India they might obtain territories.

Answer (6.) Charles II. by his marriage with Catharine of Braganza, the infanta of Portugal, was put in possession of the island of Bombay which formed a part of her marriage portion. Thus the island of Bombay fell into the hands of Charles II., who shortly after sold it to the Company for a considerable sum to gratify his pleasures.

Answer (7.) When the constitutional law of the land came to be canvassed and properly understood by the people of England, they found it unconstitutional on the part of Elizabeth in granting Charters to the Company by her sole authority. In consequence of this some of them formed themselves into companies for the right of contending for a share to the trade to the East Indies, and applied to the then reigning King, William III., for a Charter, who accordingly granted them, in 1698, by the authority of an Act of Parliament. Hence the new and rival Company came into existence.

Answer (8.) The British entered upon that career of conquest in India, so glorious to themselves, and so beneficial to the nation in 1749.

H. KERAKOOSE.

Pneumatics.

Answer (5.) If a shrivelled apple is placed in the receiver of an air-pump, and the air exhausted from it, the apple becomes plump owing to the air within the apple expanding, in consequence of its not having any external pressure. But no sooner we bring it out of the receiver, than it contracts and resumes its former state. If we take a glass tube opened at both ends, cover one end of it with a piece of bladder and exhaust the air in the tube, the bladder sinks in the tube and often bursts with a loud report, in consequence, of its being no longer able to sustain the weight of the external atmosphere. We frequently find that our blood vessels burst on ascending very high mountains. This is owing to the pressure of the atmosphere in those elevated being considerably less than that of the internal air. These are some of the experiments which illustrate both the weight and elasticity of air.

P. RUNGANADUM.

Answer (10.) Wind is, air in motion; or it is the motion of a stream or current of air caused by an increase of temperature. When any part of the atmosphere is more heated than the rest the air in that part is rendered specifically lighter than the surrounding air and consequently it rises. Then the air, from the northern and southern polar regions rushes in to restore the equilibrium. Those who live to the north of the place experience a constant north wind, and those who live to the south of the place experience a south wind; and

those who live on the spot where these winds meet and interfere experience boisterous and stormy winds.

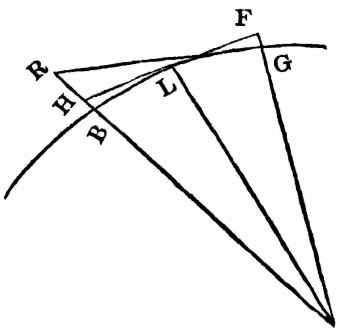
C. Samarow.

Answer (11.) At the equator as the heat of the sun is very great, the atmosphere there is always rarified and consequently it ascends and goes to the polar regions, thence the air rushes to the equator to restore the equilibrium; but as the diurnal motion of the earth is from west to east and the air from the poles is not able to keep pace with the earth at the equator, and therefore as it lags behind it, a constant east wind is observed at the equator.

P. Rungiah.

Plane Trigonometry.

Answer (8.) Let A B G represent the surface of the earth and D its centre and F G the height of a vessel; H B the height at which a person sees the top F of the vessel F G and R the height from which he sees its bottom G. In the triangle R D G the side R D is known; for B D is a radius of the earth equal to 4,000 miles, therefore R D = 4,000 miles together with 200 feet. The side G D is equal to 4,000 miles; and the $\angle$ R G D is a rt. $\angle$; therefore the angle B D G may be determined. In the $\triangle$ H D L the sides H D and D G are known and the $\angle$ H L D is a rt. $\angle$, therefore the $\angle$ H D L may be determined. Since the $\angle$ H D G and H D L are known therefore the $\angle$ L D G is known. In the $\triangle$ L D F the side L D and the $\angle$ L D F are known; and the $\angle$ D L F is a rt. $\angle$ therefore D F may be determined. If D F is determined then we subtract D G or 4,000 miles from it. Therefore the height of the ship G F is known.



P. Runganadum.

Heat.

Answer (2.) The instrument which is employed to measure the free heat of a body only to a certain degree is called the mercurial

thermometer; so called from the fluid which is used in it. It consists of a tube terminated at one end by a bulb, and the other hermetically closed. Part of the tube contains mercury and the remainder is a vacuum. But the bulb is filled with mercury. This instrument is fixed to a board graduated in two different ways; viz.; one according the Fahrenheit; and the other according to Reaumer. In Fahrenheit's scale the freezing point is 32°, and the boiling point 212°. The freezing point in Reaumer's scale is zero, and the boiling point 80°.

But the instrument that is used to measure any degree of free heat in a body is called Wedgwood's pyrometer. It consists of a brass ruler with a groove cut inside it, of a conical shape. In order to measure the degree of heat, baked clay is used, which by the application of heat contracts. The different degree of heat is ascertained by the contraction of the clay. . There is still another instrument to measure very slight degrees of heat. This is called the differential or air thermometer. This instrument consists of a glass tube bent in the middle at right angles; and terminated at both ends by two bulbs. The bulbs are filled with air and a drop of coloured liquid is poured into the tube to show clearly the contraction and expansion of the air in the bulb.

The instrument which is designed to measure the specific heat of a body is called calorimeter. It consists of a hollow sphere lined inside with ice. When a hot body whose specific heat it is required to find, is placed in this instrument; the ice absorbs its caloric, and consequently a part of the ice is melted by the heat extricated from the body. The degree of heat is ascertained by the quantity of water melted from the ice.

P. RUNGANADUM.

PRIZE ESSAY

ON

The Microscope and the Wonders disclosed by it.

So innumerable are the objects which meet our view in the heavens, that we cannot imagine any part of space, where some light

NOTE.—This essay was composed in one of the class-rooms, after preparatory study at home, and like all the other exercises contained in this Appendix, is published in exactly the same state in which it was given up by the author. As it appeared from a rigid examination that four or five sentences are verbatim, or nearly so, the same as some in one of the works which formed the subject of the preparatory study, they have been marked as quotations.

will not strike the eye. The vault of the sky arched at a vast and unknown distance over our heads, the infinite number of stars, the thousands of double and multiple systems, clusters in one blaze with their tens of thousands of stars, the nebulae amazing us by the strangeness of their forms, and the incomprehensibility of their nature,—all this makes the contemplative spectator feel, how exceedingly small a portion of the Universe he is, and how little he must be, in the eyes of an intelligence that can embrace the whole. The truth of this reflection will become more apparent when we consider, that, if such remote bodies shone by reflected light, we should be unconscious of their existence; that each star must, therefore, be a sun, and may be presumed to have its system of planets, satellites, and comets, like our own; and that for aught we know, myriads of bodies may be wandering in space, unseen by us; of whose nature we can form no idea, and still less of the part they perform in the economy of the Universe.

When we turn our eyes from the blue dome of the sky, where stars are thus multiplied, beyond what our Arithmetic can sum up, or even our imagination picture, and direct them to the earth, Oh! what an object of interminable wonder is disclosed to our view! The number of human beings who surround us, the various conditions requisite for their life and happiness,— the way in which all these conditions are modified, as we pass from one climate to another,—the almost endless tribes of animals, the forest, the field, the air, and the ocean, all teeming with creatures, whose bodily wants are as carefully provided for as man's—all this cannot but excite the wonder and admiration of the contemplator, and give him a lofty and magnificent idea of the author of so wide and rich an empire.

But when we aid our vision by Optical instruments, and take a more exact view of this spectacle, the impression of its beauty and grandeur is incalculably increased.

The number and variety of animals, a chain of organized beings extending from infinity to man, from man to nothing, the exquisite skill displayed in their structure, the endless and admirable contrivances for their maintenance and support, far exceed any thing which we could have previously imagined. But the view of the universe expands also on another side. The earth, "where teeming nature broods her myriad births," is not the only globe in the universe. There are circling about our own sun seven others, so far as we can judge perfectly analogous in their nature, besides our moon and the other satellites. No one can resist the temptation to conjecture, that

these globes, some of them much larger than our own, are not dea and barren; that they are like ours replete with organization, life, and intelligence.

But astronomy carries us still onwards. It teaches us that, with the exception of the planets, already mentioned, the stars, which we see, have no immediate relation to our system. The obvious supposition is, that they are of the nature and order of our sun. If then, these are suns, they may, like our sun, have planets revolving round them; and these may, like our planet, be the seats of vegetable, animal, and rational life. The universe does not end here. It does not end with these stars, visible to the naked and unassisted eye of man, but " ever rising with the rising mind," it bewilders his faculties, and throws him into utter hopelessness of arriving at an end. Every person probably feels, at first, lost and overwhelmed with the vastness of this spectacle, and seems to himself as it were annihilated by the magnitude and multitude of the objects, which thus compose the universe.

" All that the telescope discloses to us, is disclosed, as it were, to our ordinary vision; and in the most glorious sight that it gives us, we have always the feeling, that it is distance alone which is overcome, and that, if we could perform the journey we should get the same sight of the objects with our naked eyes. When, however, we resort to the microscope, the glory which we behold is of quite another kind." While the former seems to remove the Divine Providence further from us, the latter gives us most striking examples that it is far more active in our neighbourhood, than we supposed; while the first extends the boundaries of God's known kingdom, the second makes its known administration more minute and careful. " The little dot of mould upon a decaying stem, or a withering leaf, which to our unaided sight is merely a stain of color, and nothing more, if seen through a microscope, becomes a forest of trees, as perfect in their structures, as those, which clothe the slopes of our mountains, and give to the landscape so much both of its beauty and its fertility. Nor, is the multitude and minuteness of animated beings revealed by the microscope less wonderful; so that downward as far as the microscope can go, and we know not how much further, for we cannot imagine a limit, the display of Almighty power is as wonderful in the small, as in the great."

Reflections like these, will naturally excite the curiosity of one to

know, what there is in the nature of this mere invention of art, that makes it capable of disclosing such inestimable works of creation, and of giving such incontestable proofs of divine wisdom and providence? what there is in it, that has given man the key, which opens the way to the inmost recesses of animal and vegetable existence, and entrusts him with a source of knowledge and power, infinite in extent. When he understands, that the instrument does not consist of any complicated machinery, but of a few pieces of glass, his heart will be filled with rapture; he will grow more and more impatient to learn the construction, and modes of application of this most useful instrument. Simplicity added to utility generally renders an object more beautiful and more valuable, than it otherwise will be, and gives the mind greater satisfaction and pleasure, than any labored production, which does not boast of possessing this important element. The microscope, then, demands our attention, not only from the simplicity of its construction, but also from its extreme utility. It is supposed to have been invented about the year 1621, but by whom it is not precisely known; though it is usually attributed to a Dutchman, named Drebell. Its history, like that of nations and arts, has had its brilliant periods, in which it has shone with uncommon splendour, and been cultivated with extraordinary ardour. These have been succeeded by intervals, marked with no discovery, in which the science seemed to fade away, or at least lie dormant; till some favorable circumstance—the discovery of a new object for instance, or some new improvement in the instruments of observation—awakened the attention of the curious and animated their researches. Thus, soon after the invention of the microscope, the field it presented to observation, was cultivated by men of the first rank in science, who enriched almost every branch of natural history, by the discoveries they made with this instrument. There is scarcely any object so inconsiderable, that has not something to invite the eye of curiosity to examine it, nor is there any, which, when properly examined, will not amply repay the trouble of investigation. The microscope is for viewing minute objects, which become apparently magnified when seen through it. Of this instrument there are many kinds, varying in their structure according to the fancy of the optician; but there are only three great and important distinctions; viz., the simple, the compound, and the solar microscope. If we use a single small lens or globule of glass, to view minute insignificant objects, it is called a single microscope. In order to estimate the advantage we derive from the use of

this instrument, let us first see what defect there is in the eye, that renders it unfit for the observation of small objects.

To get a full and distinct view of any object, it has to be placed at a certain distance from the eye; and if the object be made more or less distant it is rendered obscure. If then, a very small body be placed at the proper distance from the eye, the pencils of rays that it sends forth, pass through the eye, and form an image upon the retina; but owing to its minuteness, we do not get a clear impression of the object. If, to remedy this, we bring the body nearer the eye than before, although the object appears larger, still it produces a confused image; because the pencils of rays coming from the body, tend to a focus beyond the retina, leaving mere spots of light upon it. Let us now examine the effect of a single microscope, and see how it enables the eye to get over its deficiency of power. The first effect of this is, that it decreases the degree of the divergency of the rays proceeding from the object, and makes them reach the eye, in the same way as if they came from a body at the ordinary distance of distinct vision. So that the object will not only appear distinct, but will also get additional clearness; because the lens collects, condenses, and sends to the pupil more rays than it would otherwise have. In short, the microscope gives to the minute object, a size and distinctness, which a body must have, to be seen clearly, when placed at the ordinary distance of distinct vision, and thereby lets the eye have the advantage of the augmentation of magnitude, and also removes the inconvenience arising from the too great proximity of the object. The way, in which we are to apply the single microscope, is as follows. We are to place the object, at the focus of the small lens, to secure the parallelism of the refracted rays, without which condition, the distinctness of the image, which we aim at, will not be obtained. The magnifying power of this single microscope depends upon the focal distance of the lens used, and the distance at which an object can be seen clearly. Thus if the least distance of distinct vision be 6 inches, and the focal length of the lens used 1-5th of an inch, the linear magnifying power of the instrument will be as 1-5th : 6 or as 1 : 30, and the superficial area will be as 1 : 900; that is, the object will be magnified 900 times. Then if the 6 inches remain constant, it is clear, that the magnifying power of the instrument will become greater and greater, as the focal distance of the lens used becomes less and less. Since an object is magnified more by an equally convex lens, than by a plano-convex one; since the former consists of

two spherical fragments put together; and since the focal distance of a lens grows less and less, as the convexity of the sides becomes greater and greater; it is clear that the smallest spherule of glass will be the greatest magnifier. There is, however, a limit to the size of this spherule; for if it become smaller than this limit, it is rendered useless, because of the insufficiency of the light, that will then pass through it to the eye.

Passing from this simple construction of the microscope, to the compound instrument, we see, that the latter is nothing more than an astronomical telescope inverted; where the object glass, and the eye-piece of the latter, become respectively the eye-glass and the object glass of the former. Thus, we have for the object glass of the microscope, a lens, that is, or nearly is, a small spherule, and for the eye-piece a comparatively large lens. The object to be examined with this instrument is generally placed a little beyond the focus of the object glass, to secure the formation of an image on the other side of it; and the eye-piece is so adjusted, that its focus may exactly fall where this image is formed, and so refract the rays proceeding from it in parallel directions, and send them to the organ of sight, as if they came from an object at an infinite distance, and thus contribute to a distinct image upon the retina of the eye. The chief advantage of the compound microscope is the extent of field that it commands; and this field of view may be farther increased, by interposing a field glass between the object and eye glasses, which increases the convergency and enlarges the field. The effect of this glass is to enlarge the first image of the object, and present it to the eye-piece in a larger shape than in which it would otherwise be. From the above explanation, it must be clear, whence arises the great magnifying power of the compound microscope. Were we to look with the naked eye, at the image formed by the object glass, it would itself appear larger than the object; therefore, when this picture is first magnified by the field glass, and then by the eye-piece, the body under examination must appear far larger than it would do, if viewed through a simple microscope. The magnifying power of this instrument is ascertained by compounding two proportions, which express the powers of the two lenses respectively.

The Solar Microscope consists of a plane reflector, and two lenses. The reflector collects the rays of the sun, and throws them upon a lens, that is called the condenser, which brings them to a focus. The object to be examined is not placed at the focus of this, for fear

of ite being, in any way, injured by the great heat which prevails there, but is placed very near it, to secure a great quantity of light. To this object then is presented a very powerful magnifier, in such a way, that an image of the object may be formed on a wall or screen, in a darkened room. The surface of this image increases as the square of the distance of the screen from the magnifier. When the object and the image are at equal distances from the object glass; but upon opposite sides of it, the magnitude of the image depends upon the magnifying power of that glass; and its general brightness, upon the power of the condenser. The magnifying power of this instrument, therefore, is estimated by the relative distances of the object and the image, from the object glass. For instance, if the object be at the distance of $\frac{1}{4}$ of an inch from the lens, and the screen at 20 feet, or 240 inches from it, the diameter of the image will be 960 inches, and the surface, the square of this number or 921,600 square inches. "This extent of field in the Solar microscope is of great advantage for particular exhibitions; more especially for that of minute living creatures in liquids; and as the motions of these are as much magnified in celerity, as their forms are in linear dimensions, the spectacle is rendered more imposing, in as much as, the bulk, and what we look upon as the most certain sign of life itself, are both magnified."

The wonders of the microscopic world, or of what is small in contrast of what is amazingly great, in the varied creation, are every day, by means of these powerful instruments, increasing to our view. All the three kingdoms of nature abound with objects, which, if it were not for the aid of these instruments, would never have been revealed to the naked eye of man; and who would never have, consequently, found his own insignificance in the scale of organised beings extending from infinity to the "brink of dreary nothing." Had it not been for the aid of the microscope, he would still have lingered on in the ignorance of a world, as infinite in extent as the known, "and for the book of knowledge fair," he would have been presented "with a universal blank of nature's works, wisdom being at one entrance quite shut out."

I shall now enumerate the most striking of the discoveries effected by the microscope. Tripoli is the name given to a species of stone of a uniform lightish brown color, and composed of fine particles, easily separable, and therefore easily reduced into fine powder, in which state it is used for polishing stones and metals. After a

microscopic examination of this stone, it was concluded, that it consisted of a mass of silicious cases and skeletons of microscopic animalcules! In the surface of a square inch, there were found no less than several thousands of skeletons. What, then, must have been the size of the animals to which they belonged! how small and inconceivably minute, must have been the functions of life, when the whole fabric did not occupy, even the space of the smallest grain of sand!

When we apply the microscpe to osome sponge, we are led to conclude from its great porosity, that it must have been the place of residence for some small animals. The dwellings of these animals were not, however, the large holes that we see. These, if we may so speak, "were their lanes, and streets;" they themselves living in still smaller cells, in the partitions. There are few objects more interesting, when viewed through the microscope, than the minute animals which inhabit the deep. Perhaps the most attractive of these are the polypi; among which, some live separately, and others in colonies; and small and feeble as they are, their works are gigantic. Their structures sometimes rise from the bottom of the unfathomable ocean, almost to its surface; and in some instances form the solid basis of habitable islands. These animals are almost microscopic; and when examined with the instrument, their bodily frame affords one of the strongest proofs of the Omnipotence and Wisdom of the Divine Creator.

Presenting the edge of a very keen razor to a microscope, we see it as broad as the back of a very thick knife; rough, uneven, full of notches and furrows. An exceedingly small and nice needle resembles a rough iron bar. But the sting of a bee, seen through the same instrument, exhibits every where a polish exceedingly beautiful, without the least flaw or irregularity, and ends in a point too fine to be discerned. The smallest dot, that we can make with a pen, appears, when viewed through this instrument, irregular, jagged, and uneven. But the little specks on the wings or bodies of insects, are found to be most accurately circular. In short the microscope proves the most boasted productions of art to be ill-shaped. The finest miniature paintings appear before this instrument as mere daubings, entirely void of beauty, either in the drawing, or the coloring. The most even and beautiful varnishes and polishings will be found to be mere roughness, full of gaps and flaws. Thus sink the

works of art before the microscopic eye. But the nearer we examine the works of God, even the most insignificant of his productions, the more sensible shall we be of his wisdom and power. Apply the microscope to any, the most minute of his works, nothing is to be found, but beauty and perfection. The most perfect works of art betray a meanness, a poverty, an inability, in the workman; but the works of nature plainly prove, that "the hand which formed them was Divine."

Let us turn the microscope from these external objects, and direct it to the constitution of man himself. Oh! what a glorious scene is unfolded to the view! The blood, circulating from the heart through the whole of the body, and coming back to it again, affords many subjects of inquiry to the curious. The existence of arteries and veins to conduct this fluid from one part of the constitution to another, their minuteness, beautiful construction, and adaptation in the ends of fingers and in all the small natural protuberances of the body, are subjects that call for the admiration of the examiner. The property, that these minute valves in the body have, of opening only one way, and thereby giving one road for the descending, and another for the ascending of the blood, cannot fail to excite feelings of awe and gratitude in the mind of man. An object, chiefly employed to illustrate the circulation of the blood, is the delicate transparent membrane, which unites the toes of the frog. If this membrane be extended, and fixed on a piece of glass, illuminated below, the motion of the blood in the vessels will be distinctly visible with a microscope; the appearance resembles a number of small islands, with a rapid current flowing between them.

If we take off a small piece of the epidermis, or scarf skin of the hand, by means of a sharp razor, and place it on the object plate of the microscope, we will see it covered with a multitude of small scales, so exceedingly minute, that a grain of sand will cover two hundreds of them. These scales are arranged like the tiles of a house, each covering a portion of another. In order to ascertain the form of these scales, we must scrape the skin with a penknife, and put the dust into a drop of water. Then it will be seen that these scales have in general five planes, all exceedingly minute. Underneath these scales are the holes of the epidermis, which, when the former are removed, appear like holes made by a very fine needle. In the length of an inch, no less than 1,000 of them can be counted;

so that, in a square inch, there are no less than a million of them. This is one of the wise dispensations of providence for the existence and welfare of man; since without these holes, no perspiration can take place; and man will fall a prey to all kinds of diseases. The hairs of animals, seen through a microscope, appear to be organised bodies. They are composed of long, slender, and hollow tubes. A human hair cut transversely, shows a variety of vessels in regular forms.

The most interesting microscopic spectacle, however, is a drop of putrid water, when represented on the screen of a solar microscope; because in that we see multitudes of creatures alive, and moving undisturbed in their native element. A mite was anciently thought the limit of littleness; but now we are not surprised to be told of animals several millions of times smaller than it. The excessive minuteness of microscopical animalcules conceals them from the human eye. One of the wonders of modern philosophy is to have invented means, for bringing objects, to us so imperceptible, under our cognizance and inspection; creatures thousands of times too little to affect our sense, should seem to have been very safe; yet we have extended our views over animals to whom these will be mountains. It is calculated that a thousand millions of animalcules, which are discovered in water, are not altogether so large as a grain of sand. Even the most minute of these microscopic tribes is found to possess all the functions of life, to have limbs and sinews, blood, heart, and brain, all exquisitely contrived, and beautifully adapted to the element, which it was destined to inhabit. In these microscopic tribes, whether vegetable or animal, we find that they are as true to their law of existence, as creatures of a larger growth. The mould which grows in the cell of a decaying apple, or the animalcule found in putrid water, never is met with but in that substance; and never but when that substance is in a state fitted for its appearance. But when this is the case, it never fails to be there; and if we once properly inform ourselves, of the circumstances under which it appears, we can predict its re-appearance, under similar circumstances, with absolute certainty.

Had the microscope no other recommendation, than the pleasure which it thus brings, and the very valuable lesson, which it teaches, that in the sight of God, "the extremes of measure are the same," it would have abundant claims on our attention. "The microscope, though we cannot say that it has furnished man with a new sense,

has still given to the sense of sight, a degree of improvement, which in some respects makes man a new creature, gives him a command over the productions of nature, which previous to its invention he did not possess." An untaught and a narrow minded person may then ask, why was not the eye made equivalent to a microscope ? why was it not at once rendered fit to examine the minutest of objects ? The fittest answer to this will be, think and you will see ; reflect upon the different uses of the eye, and you will find it not to be imperfect as you suppose, but the very model of perfection. The eye is fitted to view objects, that are distant, or near ; large, or small ; it is fitted to extend our contemplation to the spangled heavens, where worlds and systems of worlds revolve in perpetuity ; and also to look around us, and behold the beauty of nature on this terraqueous globe. It is fitted to survey the creation from the large whale, or "castled elephant," to the insignificant mite ; but it is not able to penetrate deeper into the world of minute beings, not only because it will then have to satisfy wants, that are diametrically opposite in their nature, but also because it will then prove a source of misery to man ; for,

" ——————————————————————If worlds
In worlds enclosed should on his senses burst,
From Cates ambrosial and the nectar'd bowl
He would abhorrent turn :"

Then, let not presumptuous ignorance " tax Creative Wisdom," as if something was imperfect, and did not harmonize with the whole ; and, standing on a baseless fabric, disallow of the Omnipotence, the Wisdom, and the beneficence, of the supreme Godhead, and thereby show ingratitude to the Author of a Universe, " by boundless love and perfect wisdom formed." Even, if after appreciating the nice and beautiful adaptation of means to an end, which pervades the Universe, should man's faltering tongue,

" Almighty Father be silent in thy praise
Thy works themselves would raise a general voice,
Even in the depth of solitary words
By human foot untrod ; proclaim thy power,
And to the quire celestial thee resound,
Th' eternal cause, support, and end of all !"

V. RAMANOOJIAH.

27th January, 1848.

No. 622.

From

G. A. BUSHBY, ESQ.,
Secy. to the Govt. of India.

To

SIR H. C. MONTGOMERY, BT.,
Secy. to the Govt. of Fort St. George.

HOME DEPARTMENT.

SIR,

I am directed to transmit, for the information of the Department of Education at the Presidency of Fort Saint George, the accompanying copy of a Dispatch from the Government of Bengal, No. 603, dated the 30th Ultimo, regarding the calculation of the Solar Eclipse that will be visible in October next, and the recommendation of the Professor of Mathematics in the Hindu College, that a variety of the examination questions of this year be made to bear on Eclipses.

I have the honor to be, &c.

G. A. BUSHBY,
Secy. to the Govt. of India.

FORT WILLIAM,
The 17th July, 1847.

No. 737.

Ordered to be communicated to the President and Governors of the Madras University, with a request that they will pursue the course pointed out, at the High School.

J. F. THOMAS,
Chief Secretary.

FORT ST. GEORGE,
9th August, 1847.

In accordance with the above order of Government, the senior scholars of the High School calculated the circumstances of the solar eclipse for Madras, and found the same by projection for Madras, Calcutta, and London. The calculations of the scholar, who distinguished himself the most in performing the various astronomical processes, were forwarded to Government by the President and Governors of the Madras University, on the 29th of September, 1847.

The Madras Government having communicated with that of Bengal, was pleased to issue the following order.

No. 185.

PUBLIC DEPARTMENT.

Extract from the Minutes of Consultation,
Dated 14th February, 1848.

Read the following letter from the Secretary to the Government of India.

Here enter 15th January, 1848.

No. 102.

The Most Noble the Governor in Council has perused with much pleasure, the satisfactory report of Professor Rees of the Hindu College, on the calculations of the late Solar Eclipse by Ramanoojum, pupil in the Madras High School ; and as a mark of the approbation of Government and as a stimulus to further exertion, His Lordship in Council desires that the calculations be published for general information in the next Annual Report of the High School ; and that the Books* noted in the margin, be presented to Ramanoojum for his successful and creditable labors.

Will be procured hereafter.

H. C. MONTGOMERY,
Offg. Chief Secretary.

With reference to the above marginal note, the undermentioned Books were presented by the Right Honorable the Governor to Ramanoojum, at the Anniversary of the Madras University held at the College Hall, on the 12th June, 1848, as a reward for his "successful and creditable labours" above-mentioned.

Pope's Works.	Smyth's Lectures on modern History.
Cowper's Works.	Dick's Celestial Scenery.
Smith's Wealth of Nations.	Locke's Works.

S. CRAWFORD,
Secretary.

The Calculation for the Solar Eclipse of October, 1847.

The following calculations are divided into three parts. In the first we find the times of beginning, middle, and end of the Solar Eclipse

to the whole earth generally ; in the second we find the above circumstances of the Eclipse *approximately*, and in the third *correctly* for Madras.

1st Division.

From the Nautical Almanac new moon or time of conjunction is equal to October $8d$, $21h$, $6m$, $36s$. Greenwich mean time.

(1). To find the sun's and moon's common longitude at conjunction.

The longitude of the sun on the 9th = 195° 34′ 21·3″
Do. do. 8th = 194° 35′ 0·4″
The difference of longitude for 24 hours = 59′ 20·9″
By proportion the difference of long. for $24h$ $6{\cdot}6m$. = 52′ 12·1″
But the longitude of the sun on the 8th = 194° 35′ 0·4″
The sun's long. at conjunction = 195° 27′ 12·5″

This is also the long. of the moon.

(2.) To find the moon's latitude at conjunction.

This has to be done by using differences.

The lat. of the moon on

		1st diff.	*2d diff.*	*3d diff.*
$8d$ $12h$ = 0° 6′ 25·8″				
		+32′ 41·3″		
Do. do. $9d$ $0h$ = 0° 39′ 7·1″			—22·9″	
		+32′ 18·4″		—19·8″
Do. do. $9d$ $12h$ = 1° 11′ 25·5″			—42·7″	
		+31′ 35·7″		
Do. do. $10d$ $0h$ = 1° 43′ 1·2″				

$$y = a + d_1 x + d_2 \frac{x.\overline{x-1}}{1.2} + d_3 \frac{x.x\overline{-1.x-2}}{1.\ 2\ 3} + \text{\&c. the formula of differences.}$$

Here a = 6′ 25·8″; d_1 = 32′ 41·3″; d_2 = —22·9″; d_3 = —19·8″

$$x = \frac{21h\ 6{\cdot}6m - 12h}{12} = \frac{9{\cdot}11h}{12}$$

By substitution $d_1 x$ = 32′ 41·3″ × $\frac{9{\cdot}11}{12}$ = 1961·3″ × $\frac{9{\cdot}11}{12}$

$$= \frac{17867{\cdot}443}{12} = 1488{\cdot}95'' = 24'\ 48{\cdot}95''$$

$$d_2 \frac{x.\overline{x-1}}{1.2} = -22{\cdot}9' \times \frac{9{\cdot}11 \times \overline{9{\cdot}11-12}}{\frac{144}{1.2}} = -22{\cdot}9'' \times \frac{9{\cdot}11 \times -2{\cdot}89}{288}$$

$$= -22{\cdot}9 \times -{\cdot}0914 = 2{\cdot}09''$$

$$d_3 \frac{x.\overline{x-1}.\overline{x-2}}{1.\ 2.\ 3} = -19{\cdot}8'' \times \frac{9{\cdot}11 \times -2{\cdot}89 \times -14{\cdot}89}{144 \times 12 \times 6}$$

$$= -19{\cdot}8 \times \frac{392{\cdot}022431}{10368} = -19{\cdot}8 \times {\cdot}0378 = -{\cdot}748, \text{ \&c.}$$

$$a = 6' 25{\cdot}8''$$
$$d_1 x = 24' 48{\cdot}95''$$
$$d_2 \frac{x.\overline{x-1}}{1{\cdot}2} = \quad 2{\cdot}09$$
$$d_3 \frac{x.\overline{x-1}.\overline{x-2}}{1.\ 2.\ 3} = \quad -{\cdot}748$$

$y = 31' 16{\cdot}092''$ or $31' 16{\cdot}1'' =$ moon's lat. at conjunction.

(3.) To find the moon's horary motion in longitude.

We know the moon's long. on $8d\ 21h\ 6{\cdot}6m$.

To get the horary motion in long. we have to find the long. of the moon on $8d\ 22h\ 6{\cdot}6m$ and the difference between the two will be the horary motion in longitude.

In this also we have to use differences.

The moon's long. on

			1st diff.	2d diff.	3d diff.
	$8d\ 12h$	$= 190° 58' 43{\cdot}1''$			
Do. do.	$9d\ 0h$	$= 196° 52' 26{\cdot}2''$	$+5° 53' 43{\cdot}1''$		
Do. do.	$9d\ 12h$	$= 202° 46' 40''$	$+5° 54' 13{\cdot}8''$	$+30{\cdot}7''$	
Do. do.	$10d\ 0h$	$= 208° 41' 40{\cdot}3''$	$+5° 55' 0{\cdot}3''$	$+46{\cdot}5''$	$+15{\cdot}8''$

We use the same formula as in (2).

Here $a = 190° 58' 43{\cdot}1''$; $d_1 = 5° 53' 43{\cdot}1''$; $d_2 = 30\ 7''$; $d_3 = 15{\cdot}8''$

$x = \frac{10{\cdot}11}{12}$ by a similar method as in (2).

$$d_1 x = 5° 53' 43{\cdot}1'' \times \frac{10{\cdot}11}{12} = 21223{\cdot}1'' \times \frac{10{\cdot}11}{12} = \frac{214565{\cdot}541}{12}$$
$$= 17880{\cdot}461'' = 4° 58' 0{\cdot}46''$$
$$d_2 \frac{x.\overline{x-1}}{1{\cdot}2} = 30{\cdot}7'' \times \frac{10\ 11 \times -1{\cdot}89}{288} = 30{\cdot}7'' \times \frac{-19{\cdot}1079}{288}$$
$$= 30{\cdot}7'' \times -{\cdot}0663 = -\ 2\ 03''$$
$$d_3 \frac{x.\overline{x-1}.\overline{x-2}}{1.\ 2.\ 3} = 15{\cdot}8'' \times \frac{10{\cdot}11 \times -1{\cdot}89 \times -13{\cdot}89}{288 \times 12 \times 3} = 15\ 8'' \times \frac{265{\cdot}408731}{10368}$$
$$= 15{\cdot}8 \times {\cdot}0255'' = {\cdot}40, \text{ &c.}$$

$$a = 190° 58' 43{\cdot}1''$$
$$d_1 x = \quad 4° 58' 0{\cdot}46''$$
$$d_2 \frac{x.\overline{x-1}}{1.\ 2} = \quad -\ 2{\cdot}03$$
$$d_3 \frac{x.\overline{x-1}.\overline{x-2}}{1.\ 2.\ 3} = \quad {\cdot}40$$

$y = 195° 56' 41{\cdot}93'' =$ long. on $8d\ 22h\ 6{\cdot}6m$.

$195° 27' 12{\cdot}5'' =$ long. on $8d\ 21h\ 6{\cdot}6m$.

$29' 29{\cdot}43'' =$ moon's H. M. in long.

(4.) To find the sun's horary motion in longitude.

The sun's long. on the 9th = 195° 34′ 21·3″
Do. do. 8th = 194° 35′ 0·4″
Difference of long. for 24 hours 59′ 20·9″
Dividing this difference by 24.
The horary motion of the sun in long. = 2′ 28·4″

(5.) To find the moon's relative horary motion in long.

This is found by subtracting the sun's horary motion from the horary motion of the moon.

Moon's horary motion in long. = 29′ 29·43″
Sun's do. do. do. = 2′ 28·4″
Moon's relative horary motion in long. = 27′ 1 = f = 1621″

(6.) To find the moon's horary motion in latitude.

This has to be done by using differences. The quantities to be used in this are all the same as those in (2) except x which $= \frac{10 \cdot 11}{12}$; for we have to work for 22 hours instead of 21 hours.

$$d_1 x = 32' 41 \cdot 3'' \times \frac{10 \cdot 11}{12} = 1961 \cdot 3'' \times \frac{10 \cdot 11}{12} = 1652 \cdot 395''$$

$$= 27' 32 \cdot 4''$$

$$d_2 \frac{x.\overline{x-1.}}{1.\ 2.} = -22 \cdot 9'' \times \frac{10 \cdot 11 \times -1 \cdot 89}{288} = -22 \cdot 9'' \times \frac{-19 \cdot 1079}{288}$$

$$= -22 \cdot 9 \times -\cdot 0663 = 1 \cdot 5''$$

$$d \frac{x.\overline{x-1.}\ \overline{x-2.}}{1.\ 2.\ 3.} = -19 \cdot 8'' \times \frac{10 \cdot 11 \times -1 \cdot 89 \times -13 \cdot 89}{10368} = -19 \cdot 8'' \times \cdot 0256$$

$$= -\cdot 50, \text{ \&c.}$$

a = 6′ 25·8″
$d_1 x$ = 27′ 32·4″

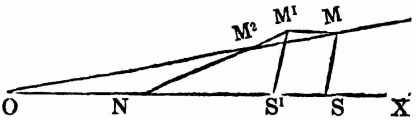
$$d_2 \frac{x.\overline{x-1}}{1.\ 2} = 1 \cdot 5$$

$$d_3 \frac{x.\overline{x-1.}\ \overline{x-2.}}{1.\ 2.\ 3.} = -\cdot 50$$

y = 33 59·2 = moon's lat. on 8d 22h 6·6m.
31 16·1 = moon's lat. on 8d 21h 6·6m.
2 43·1 = moon's horary motion in lat.
= g = 163·1″

(7.) To find the inclination of the relative orbit of the moon to the ecliptic.

By the relative orbit of the moon is meant that imaginary path which the moon would describe, if the sun were stationary, and if instead of her proper velocity, she had only the difference between her velocity and that of the sun. We introduce this orbit, for it is hard to grasp the idea of *two* bodies moving with *unequal* velocities. To draw the relative orbit of the moon, suppose OX to be the ecliptic, OM the true path of the moon, S the place of the sun, and M that of the moon.



Supposing that the sun and moon will come into conjunction at S^1 and M^2, the sun would have passed through S S^1 and the moon through M M^2. Instead of the sun being at S let us suppose him to be at S^1, and to have no motion; then in order to keep the distance between him and the moon the same, we have to remove the moon from M to M^1, a distance equal to S S^1. At M the moon has the same latitude as at M; for M M^1 is parallel to S S^1. Now the moon must pass through M^2, as that is the point of conjunction; therefore the two points M^1 and M^2 being fixed, the line joining them, produced, will be the relative orbit; and M^1 N S the $\angle$ of inclination of the relative orbit.

$$\text{Tan } M^1 N S \text{ or tan } N = \frac{\text{moon's H. M. in lat.}}{\text{moon's relative H. M. in long.}}$$

$$= \frac{g}{f} = \frac{163{\cdot}1''}{1621}$$

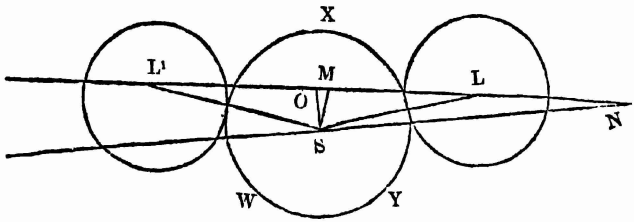
$$\text{Log tan } N = l\,163{\cdot}1 - l\,1621 + 10$$
$$= 2{\cdot}2124\ 540 - 3{\cdot}2097830 + 10$$
$$= 12{\cdot}2124540 - 3{\cdot}2097830$$
$$= 9{\cdot}0026710$$

$N = 5^\circ\ 44'\ 44'' = \angle$ of inclination of the relative orbit of the moon to the ecliptic.

(8). To find S M or the shortest distance between the sun and moon.

S is the centre of the sun WYX; L and L′, the centres of the moon at the beginning and end of the eclipse; N M O the relative orbit of the moon; S M a line $\perp r$ to N M; and S O $\perp r$ to N S.

By the Sixth Book of Euclid the $\triangle s$ S M O and N O S are similar and therefore $\angle M S O = \angle O N S = \angle N$



$$S M = O S \times \cos O S M$$
$$= O S \times \cos O N S$$
$$= \lambda \times \cos 5^\circ 44' 44''\text{; where } \lambda = \text{lat. of moon} = O S$$
$$\text{Log } S M = l\lambda + L \cos 5^\circ 44' 44'' - 10 - \lambda = 1876{\cdot}1'' \text{ by (2).}$$
$$= 3{\cdot}2732560 + 9{\cdot}9978127 - 10.$$
$$= 3{\cdot}2710687$$
$$S M = 1866{\cdot}7'' = 31' 6{\cdot}7''$$

(9). To find the distance between M and the point of one junction or O.

From the $\triangle$ O M S

$$O M = O S \times \sin O S M$$
$$= \lambda \times \sin 5^\circ 44' 44''$$
$$\text{Log } O M = l\lambda + L \sin 5^\circ 44' 44'' - 10$$
$$= 3{\cdot}2732560 + 9{\cdot}0004809 - 10$$
$$= 2{\cdot}2737369$$
$$O M = 187{\cdot}8'' = 3' 7{\cdot}8''$$

(10). To find the horary motion of the moon in the orbit.

H. M. in the orbit = H M in lat $\div$ by the sine of the angle of inclination.

$$= \frac{g}{\sin n}$$
$$\text{L. H. M.} = l g - L \sin n + 10$$
$$= l\ 163{\cdot}1'' - L \sin 5^\circ 44' 44'' + 10$$
$$= 12{\cdot}2124540 - 9{\cdot}0004809$$
$$= 3{\cdot}2119731$$
$$\text{H. M.} = 1629{\cdot}2'' = 27' 9{\cdot}2'' = H.$$

(11). To find the time that the Moon will take to move from M to O.

$$T = \frac{M O}{H} = \frac{187{\cdot}8}{1629{\cdot}2} \times 3600$$

Log. T = l 187·8 + l 3600 — l 1629·2
= 2·2737369 + 3·5563025 — 3·2119731
= 2·6180663
T = 415·02s = 6m 55·02s.

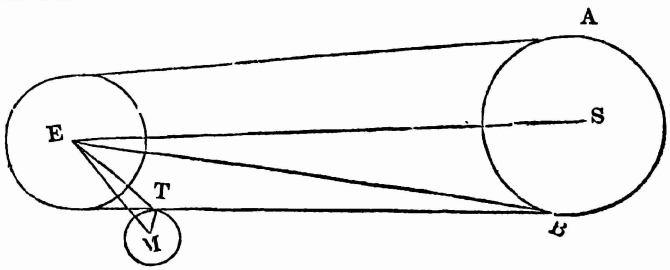
(12). To find the time at M.

Since we know the time of conjunction or that is the time at O, the time at M can be found by subtracting from the time of conjunction the time that the Moon takes to move from M. to O.

Time at O = 8d 21h 6m 36s.
Time from M to O = 6m 55·02s.
Time at M = 8d 20h 59m 40·98s.

(13.) To find the angular distance of the Sun and Moon at the beginning of the eclipse.

In the annexed figure A B is the Sun, S his centre, E the Earth, M the Moon just entering the cone of light which the Sun sends to the Earth. Join E B, E S, E T, and E M. The angular distance therefore between the sun and moon is S E M.



σ = Semidiameter of the sun
p = Do. of the moon
π = Parallax of the sun
P = Do. of the moon

S E M = S E B + B E T + T E M
= σ + P — π + p

The angular radius of the luminous cone
at the moon = S E T = S E B + B E T
= σ + P — π = a

Moon's Equatorial horizontal parallax = 53′ 54·5″
= 3234·5″

l 3234·5 = 3·50981
l ρ = 9·99929 — ρ = radius vector corresponding to lat. 45°.
l 3229·2 = 3·50910

$$
\begin{array}{rl}
P = & 53'\ 49{\cdot}2'' \\
\sigma = & 16\ \ \ 2\ {\cdot}6 \\
p = & 14\ \ 41\ {\cdot}4 \\
P = & 53\ \ 49\ {\cdot}2 \\
\hline
\sigma + p + P = & 1^\circ\ 24'\ 33{\cdot}2'' \\
\Pi = & \qquad\quad 8\ {\cdot}6 \\
\hline
\sigma + p + P - \Pi = & 1\ \ 24\ \ 24\ {\cdot}6 = \text{angular distance of the sun and moon.} \\
\hline
& 1^\circ\ 24'\ 24{\cdot}6'' = \text{angular distance of the sun and moon.} \\
& \quad 14\ \ 41{\cdot}4 = p \\
\hline
& 1\ \ 9\ \ 43{\cdot}2 = \text{angular radius of the luminous cone.} \\
& \qquad\qquad\quad = a
\end{array}
$$

(14.) To find S L in figure (2) or the distance between the centres of the sun and moon at the beginning of the Eclipse.

$$
\begin{aligned}
S\,L &= \angle r \text{ radius of the cone of light} + \text{ radius of moon.} \\
&= a + p. \\
&= 1^\circ\ \ 9'\ 34{\cdot}2'' + 14.'\ 41{\cdot}4'' \\
&= 1^\circ\ 24'\ 24{\cdot}6'' = 5064{\cdot}6''
\end{aligned}
$$

(15.) To find M L in the same figure. This is found by applying the 47th proposition of the 1st Book of Euclid.

$$
\begin{aligned}
S\,M &= 1866{\cdot}7 \qquad (8) \\
S\,L &= 5064{\cdot}6 \qquad (14).
\end{aligned}
$$

$$
\begin{aligned}
M\,L &= \sqrt{S\,L^2 - S\,M^2} = \sqrt{\overline{5064{\cdot}6}^2 - \overline{1866{\cdot}7}^2} \\
&= \sqrt{25650173{\cdot}16 - 3484568{\cdot}89} \\
&= \sqrt{22165604{\cdot}27} \\
&= 4708{\cdot}03'' = 1^\circ\ 18'\ 28{\cdot}03''
\end{aligned}
$$

H. M. in orbit $= 1629{\cdot}2''$

$$\text{Time from L to M} = \frac{4708{\cdot}03''}{1629{\cdot}2} = 2h\ 53m\ 23{\cdot}2s$$

$2h\ 53m\ 23s\ 2 \times 2 = 5h\ 46m\ 46{\cdot}4s =$ time of duration of the eclipse.

Time at M $= 8d\ 20h\ 59m\ 41{\cdot}1s$.
Time from L to M $= 2h\ 53m\ 23{\cdot}2s$.

$8d\ 18h\ \ 6m\ 17{\cdot}9s =$ time of commencement of the eclipse.

$8d\ 18h\ \ 6m\ 17{\cdot}9s =$ time of commencement.
$5h\ 46m\ 46{\cdot}4s =$ time of duration.

$8d\ 23h\ 53m\ \ 4{\cdot}3s$ = time of termination of the eclipse.

Longitude of Madras = $5h\ 21m\ 3{\cdot}8s$.

Madras mean time of commencement = $8d\ 23h\ 27m\ 21\ 7s$

Time of the middle of the eclipse = $9d\ \ 2h\ 20m\ 44{\cdot}9s$.

Time of termination = $9d\ \ 5h\ 14m\ \ 8{\cdot}1s$.

2D DIVISION.

To find the approximate times of beginning, middle, and end of the eclipse to Madras.

In the 1st division we had the time of conjunction as $8d\ 21h\ 6m\ 36s$; but the parallax corresponding to the latitude of Madras will throw this conjunction somewhere about an hour later. We will therefore find the apparent positions of the sun and moon on October $8d\ 22h\ 6m\ 36s$ G. M. T.

Madras mean time = $9d\ 3h\ 27m\ 39{\cdot}77s$.

Equation of time = $12m\ 32{\cdot}34s$.

Madras true time = $9d\ 3h\ 40m\ 12{\cdot}11s$.

Sun's AR. at this time = $12h\ 57m\ \ 4\ 5s$.

Hour ∠ from noon = $3h\ 40m\ 12{\cdot}11s$.

AR. of mid-heaven = $16h\ 37m\ 16{\cdot}61s$.

= $249°\ 19'\ 9\ 2''$

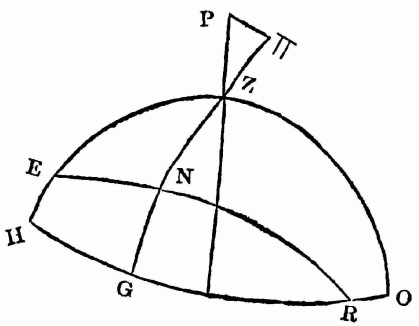
Sun's long. = $195°\ 29'\ 40{\cdot}8''$

Moon's long. = $195°\ 56'\ 41{\cdot}9''$

Moon's lat. = $33'\ 59{\cdot}2''$

To find the height and longitude of the nonagesimal.

In the annexed figure H R O is the horizon of Madras; E N R the position of the ecliptic at the given time; ♈ and P the poles of the ecliptic and equator respectively; Z the zenith of Madras; and ♈ Z N G a circle of latitude cutting E N R in N the nonagesimal.



$\Upsilon Z = N G$ = height of nonagesimal
$90 + P \Upsilon Z$ = long. of do.
$P \Upsilon$ = obliquity of the ecliptic = 23° 27′ 24″
13° 4′ 9″ = latitude of Madras.
4′ 45″ = reduction to centre.

12 59 24 = reduced lat. of Madras.

$P Z = 90° - 12° 59' 24'' = 77° 0' 36''$
$\Upsilon P Z = 270° - 249° 19' 9{\cdot}2'' = 20° 40' 50\ 8''$

Now in the triangle $\Upsilon P Z$,

$$\text{Cos } \Upsilon Z = \text{Cos } \Upsilon P \times \text{Cos } P Z + \text{Sin } \Upsilon P. \text{ Sin } P Z. \text{ Cos. } \Upsilon P Z.$$
$$= \text{Cos } \Upsilon P \times \text{Cos } P Z \left\{ 1 + \tan \Upsilon P. \tan P Z. \text{Cos } \Upsilon P Z \right\}$$

Let $\tan^2 \theta = \tan \Upsilon P. \tan P Z. \text{Cos. } \Upsilon P Z$

$$\text{Cos } \Upsilon Z = \text{Cos } \Upsilon P \times \text{Cos } P Z \times \text{Sec}^2 \theta$$
$$2 \text{ L tan } \theta = \text{L tan } \Upsilon P + \text{L tan } P Z + \text{L cos } \Upsilon P Z - 10$$
$$\text{L cos } \Upsilon Z = \text{L cos } \Upsilon P + \text{L cos } P Z + 2 \text{ L sec } \theta - 30$$

L tan 23° 27′ 24″ = 9 6374030
L tan 77° 0′ 36″ = 10·6369819
L cos 20° 40′ 50·8″ = 9·9710728

2 | 20·2454577
10·1227288 = L tan 52° 59′ 24″

$\theta = 52° 59' 24''$

L cos 23° 27′ 24″ = 9·9625405
L cos 77 0 36 = 9·3517595
L sec 52 59 24 = 10 2204364
L sec 52 59 24 = 10 2204364

9 7551728 = L cos 55° 18′ 50″

$\Upsilon Z = 55° 18' 50''$ = height of nonagesimal

Again in $\triangle P \Upsilon Z$

$$\text{Sin } P \Upsilon Z = \text{Sin } \Upsilon P Z \frac{\text{Sin } PZ}{\text{Sin } \Upsilon Z}$$
$$\text{L Sin } P \Upsilon Z = \text{L Sin } \Upsilon P Z + \text{L Sin } P Z - \text{L Sin } \Upsilon Z$$

L Sin 77° 0′ 36″ = 9·9887414
L Sin 20 40 50·8 = 9·5479727

19·5367141
L Sin 55° 18 50″ = 9·9150208

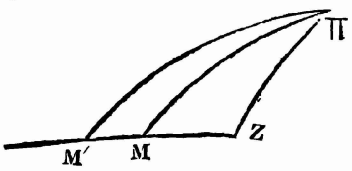
$9{\cdot}6216933 = \text{L Sin } 24^\circ\ 44'\ 23''$

$\text{P} \prod \text{Z} = 180^\circ - 24^\circ\ 44'\ 23'' = 155^\circ\ 15'\ 37''$

$\text{Long. of nonagesimal} = 90^\circ + 155^\circ\ 15'\ 37'' = 245^\circ\ 15'\ 37''$

To find the parallaxes of the moon in latitude and longitude at the above time.

Let $\prod$ be the pole of the ecliptic, Z the zenith of Madras, M the moon depressed by parallax to M′ in the vertical circle Z M M′. Join $\prod$ M and $\prod$ M′ Then $\prod$ M′—$\prod$ M is equal to the moon's parallax in latitude and the $\angle$ M $\prod$ M′ her parallax in longitude.



$\prod \text{Z} = 55^\circ\ 18'\ 50''$

$\prod \text{M} = 90^\circ - 33'\ 59{\cdot}2'' = 89^\circ\ 26'\ 0{\cdot}8''$

$\text{Z} \prod \text{M} = \text{long. N} - \text{long. of moon} = 49^\circ\ 18'\ 55{\cdot}1''$

Now in the $\triangle$ M $\prod$ Z we have

$2 \log \tan \theta = \text{L tan } \prod \text{Z} + \text{L tan } \prod \text{M} + \text{L cos Z} \prod \text{M} - 10$

$\text{L cos Z M} = \text{L cos } \prod \text{Z} + \text{L cos } \prod \text{M} + 2 \text{ L sec } \theta - 30$

$\text{L tan } \prod \text{Z} = 10{\cdot}1598473$

$\text{L tan } \prod \text{M} = 12{\cdot}0049537$

$\text{L cos Z } \prod \text{M} = 9{\cdot}8141782$

$2 \mid 21{\cdot}9789792$

$10{\cdot}9894896 = \text{L tan } 84^\circ\ 9'\ 2''$

$\theta = 84^\circ\ 9'\ 2''$

$\text{L cos } \prod \text{Z} = 9{\cdot}7551735$

$\text{L cos } \prod \text{M} = 7{\cdot}9950276$

$\text{L sec } \theta = 10{\cdot}9917628$

$\text{L sec } \theta = 10{\cdot}9917628$

$9{\cdot}7337268 = \text{L cos } 57^\circ\ 12'\ 12''$

$\text{Z M} = 57^\circ\ 12'\ 12''$

Moon's $||^x$ = Horizontal $||^x$ Sin Z M′.

Equatorial horizontal $||^x$ of the moon = $53'\ 54{\cdot}7''$

Madras horizontal $||^x$ of the moon = $53'\ 54{\cdot}3''$

$= 3234{\cdot}3''$

1st approximation. $M M' = 3234{\cdot}3 \times \text{Sin } Z M'$

$L\ M M' = l\ 3234{\cdot}3 + L \text{ Sin } Z M' - 10$

$l\ 3234{\cdot}3 = 3{\cdot}5097803$

$L \text{ Sin } Z M = 9{\cdot}9245884$

$3{\cdot}4343687 = l\ 2718\ 8''$

$57^\circ\ 12'\ 12''$

$45\ 18{\cdot}8$

$57\ 57\ 30{\cdot}8 = Z M'$ $\qquad M M' = 2718{\cdot}8'' = 45'\ 18\ 8''$

2d approximation.

$l\ 3234{\cdot}3 = 3{\cdot}5097803$

$L \text{ Sin } Z M' = 9{\cdot}9282240$

$3{\cdot}4380043 = l\ 2741{\cdot}6''$

$M M' = 2741{\cdot}6'' = 45'\ 41{\cdot}6''$

3d approximation.

$M M' = 45'\ 41{\cdot}8''$

Again in $\triangle$ Z ∏ M

$$\text{Sin } Z M \prod = \text{Sin } Z \prod M \frac{\text{Sin } Z \prod}{\text{Sin } Z M}$$

$L \text{ Sin } Z M \prod = L \text{ Sin } Z \prod M + L \text{ Sin } Z \prod - L \text{ Sin } Z M.$

$L \text{ Sin } Z \prod M = 9{\cdot}8798459$

$L \text{ Sin } Z \prod = 9{\cdot}9150208$

$19{\cdot}7948667$

$L \text{ Sin } Z M = 9{\cdot}9245884$

$9{\cdot}8702783 = L \text{ Sin } 47^\circ\ 53'\ 1''$

$Z M \prod = 47^\circ\ 53'\ 1''$

In the $\triangle$ M ∏ M′

$M M' = 45'\ 41{\cdot}8''$; $\prod M = 89^\circ\ 26'\ 0{\cdot}8''$, $\prod M M' = 180^\circ - \prod M Z.$

$\text{Cos} \prod M' = \cos \prod M. \cos M M' - \sin \prod M. \sin M M'. \cos \prod M Z.$

$L \cos \prod M = 7{\cdot}9950276$ $\qquad L \text{ Sin } \prod M = 9{\cdot}9999788$

$L \cos M M' = 9\ 9999616$ $\qquad L \text{ Sin } M M' = 8{\cdot}1235978$

$l 0098853 = \bar{3}\ 9949892$ $\qquad L \cos \prod M Z = 9{\cdot}8264887$

$l 0089139 = \bar{3}{\cdot}9500653$

$\cdot 0098853$

$\cdot 0089139$

$\cdot 0009714$

Cos ☋ M′ = ·0009714

L Cos ☋ M′ = 6 9873981 = L cos 89° 56′ 39·6″

☋ M′ = 89° 56′ 39·6″

☋ M = 89 26 0·8

30 38·8 = moon's ||ˣ in lat.

= 1838·8″

Again Sin M ☋ M′ = Sin ☋ M Z. $\frac{\text{Sin M M}'}{\text{Sin ☋ M}'}$

L Sin M ☋ M′ = L Sin ☋ M Z + L Sin M M′—L Sin ☋ M′

L Sin ☋ M Z = 9·8702783

L Sin M M′ = 8 1235978

17·9938761

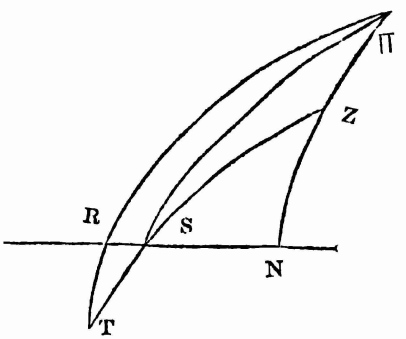
L Sin ☋ M′ = 9·9999998

7·9938763 = L Sin 33′ 53·8″

Moon's ||ˣ in long. = 33′ 53·8″

Moon's lat. = 33′ 59·2″	moon's long. = 195° 56′ 41·9″
||ˣ = 30 38·8	||ˣ = 33 53·8
Moon's apparent lat. = 3 20·4	Moon's apparent long. = 195 22 48 1

In the annexed figure S N is the Ecliptic; S the Sun depressed by ||ˣ to T in the vertical circle Z S T; ☋ S and ☋ R T two circles of latitude passing through the true and apparent places of the Sun. Since △ R T S is very small we may treat it as a rectilinear right angled triangle.



R S = S T. Cos. R S T = ☋ Sin. Z S Cos. Z S N.

= ☋ Sin. Z S Sin. Z S ☋.

= ☋ Sin. Z ☋ Sin. Z ☋ S.

Also R T = S T. Sin. R S T = ☋ Sin. Z S. Sin. Z S N.

= ☋ Sin. Z N.

Z $\prod^{*}$ S = long. N—long. Sun = 49° 45′ 56·2″
Z $\prod$ = 55° 18′ 50″; Z N = 90°—Z $\prod$; $\prod$ = 8 6″
l R S = $l \prod$ + L Sin. Z $\prod$ + L Sin. Z $\prod$ S—20.
l R T = $l \prod$ + L Sin. Z N—10.
L Sin. Z $\prod$ = 9·9150208.
L Sin. Z $\prod$ S = 9.8827570.
L $\prod$ = ·9344985.

L 5·4″ = ·7322763 = Sun's ||^{x} in long. = R S.

L Sin Z N = 9·7551735.
L $\prod$ = ·9344985.

L 4·9″ = ·6896720 = Sun's ||^{x} in lat. = R T.

Sun's long. = 195° 29′ 40·8″
||^{x} = 5·4″ Sun's lat. = 4·9″ South.

Sun's apparent long. = 195° 29′ 35·4″

Moon's apparent lat. = 3′ 20·4″
Sun's do. = 4·9″

Apparent difference of lat. = 3′ 25·3″

Sun's apparent long. = 195° 29′ 35·4″
Moon's do. do. = 195° 22′ 48·1″

Apparent difference of long. = 6′ 47·3″

Since from the above calculations we see that on 8*d*. 22*h*. 6*m*. 36*s*. the Sun's longitude is greater than the Moon's we know that the bodies have not come into conjunction yet and will therefore find the apparent places of the Sun and Moon an hour later or on 8*d*. 23*h*. 6*m*. 86*s*. G. M. T.

Madras mean time = 9*d*. 1*h*. 27*m*. 39·77*s*.
Equation of time = 12*m*. 33·02*s*.

Madras true time = 9*d*. 4*h*. 40*m*. 12·79*s*.

Sun's AR at this time = 12*h*. 57*m*. 13·67*s*.
Hour ∠ from noon = 4*h*. 40*m*. 12·79*s*.

AR of mid-heaven = 17*h*. 37*m*. 26·46*s*.
= 264° 21′ 36·9″

Sun's long. = 195° 32′ 9·2″

Moon's long. = 196° 26′ 11·3″
Moon's lat. = 36′ 42·4″

To find the height and long. of nonagesimal.

The construction and explanation of the figure are as before.*

P ⋔ = 23° 27′ 24″
P Z = 77° 0′ 36″
⋔ P Z = 270°—264° 21′ 36·9″
= 5° 38′ 23·1″

Formula as before, the △ being P ⋔ Z

θ = 53° 50′ 12″
⋔ Z = 53° 41′ 13″

Height of nonagesimal = 53° 41′ 13″

The formula as before.

P ⋔ Z = 180°—6° 49′ 30″=173° 10′ 30″
Long. of N = 90°+173° 10′ 30″=263° 10′ 30″

To find the parallaxes of the Moon in latitude and longitude at the above time.

⋔ Z = 53° 41′ 13″
Z ⋔ M = 66° 44′ 18·7″
M ⋔ = 89° 23′ 17·6″

Formula as before.

θ = 81° 58′ 36″
Z M = 71° 3′ 38″

Moon's Equatorial horizontal ∥ = 3235″
Madras do. = 3234·6″
∴ M M′ =51′ 14·8″

To find ∠ ⋔ M Z

Formula as before.

⋔ M Z = 51° 30′ 20″

To find ⋔ M.′

* Many of the logarithmic processes belonging to the succeeding portion of this calculation, being of exactly the same nature as some already given in full, are omitted, and the data and results alone put down.

Formula as before.

$\pi M' = 89° 55' 12{\cdot}1''$

$\pi M = 89° 23' 17\ 6''$

$31' 54{\cdot}5'' =$ moon's $||^x$ in lat.

$= 1914\ 5''$

Moon's $||^x$ in long. $= 40' 6\ 5'' = 2406{\cdot}5''$

Moon's lat. $= 36' 42\ 4''$ Moon's long. $= 196° 26' 11{\cdot}3''$

$||^x = 31' 54{\cdot}5''$ $||^x = 40' 6{\cdot}5''$

Moon's apparent lat. $= 4' 47{\cdot}9''$ Moon's apparent long. $= 195° 46' 4\ 8''$

To find the Sun's $||^{xes}$ in lat. and long.

Figure as before.

$\pi Z = 53° 41' 13''$

$Z \pi S =$ long. N—long. S $= 67° 38' 20{\cdot}8''$

$\pi =$ Sun's horizontal $||^x = 8{\cdot}6''$

Formula as before.

$6{\cdot}4'' =$ Sun's $||^x$ in long.

$5{\cdot}1'' =$ Sun's $||^x$ in lat.

Sun's long. $= 195° 32' 9{\cdot}2''$

$||^x = 6\ 4''$ Sun's apparent lat. $= 5{\cdot}1''$ South.

Sun's apparent long. $= 195° 32' 2{\cdot}8''$

Moon's long. $= 195° 46' 4{\cdot}8''$

Sun's long. $= 195° 36' 2{\cdot}8'$

Apparent difference of long. $= 14' 2 = 842''$

Moon's lat. $= 4' 47\ 9''$

Sun's lat. $= 5\ 1''$

Apparent difference of lat. $= 4' 53'' = 293''$

From this calculation we see that since the longitude of the Moon is greater than that of the Sun, the time of conjunction is past and we have seen before that on *8d. 22h. 6m. 36s.* the bodies have not come into conjunction. We may therefore conclude the time of conjunction to be somewhere between the two hours 22 and 23.

Apparent relative change of long. in one hour $= 1219{\cdot}3''$

Do. do. lat. do. $= 87{\cdot}7''$

At *9d. 3h. 27m. 39·77s.* the apparent distance of Sun and Moon in long. $= 407{\cdot}3'$

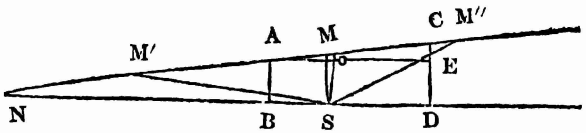
1249·3″ : 407·3 : : 1*h* : 19*m*. 33·6*s* interval from preceding time to time of apparent conjunction.

∴ 9*d*. 3*h*. 47*m*. 13·37*s*. = time of apparent conjunction.

Apparent difference of lat. at 9*d*. 3*h*. 47*m*. 39·77*s*. = 205·3″
Increase for 19*m*. 33·6*s*. = 28·6″
Apparent difference of lat. apparent conjunction = 233·9″

In the annexed figure N D is a parallel to the ecliptic, S the Sun at apparent conjunction supposed stationary, AE a parallel to N D, and N A C the apparent relative path of the Moon, and O is the place of the Moon at apparent conjunction.

S B = 407·3″
S D = 842
B A = 205·3″
C D = 293



C E = C D—A B = 87·7″
S O = 233·9″

$$A\,C = \sqrt{BS + SD^2 + CE^2} = \sqrt{1249{\cdot}3^2 + 87{\cdot}7^2}$$

= 1252·3″ = horary motion in apparent relative orbit.

1252·3 : 1249·3 : : 233·9 : S M ⊥ᵣ on A C = 233·3″

S M is the shortest distance between the centres of the Sun and Moon.

1252·3 : 87·7 : : 233·9 : M O = 16·4
1252·3 : 16·4 : : 1 : time through M O = 47·1*s*.

∴ Time at M = time at O—time through M O
= 9*d*. 3*h*. 46*m*. 26·27*s*.

Moon's apparent horizontal radius = 14′ 41 5″
Augmentation for 30° altitude = 7′

Moon's apparent radius at apparent conjunction = 14′ 48·5″

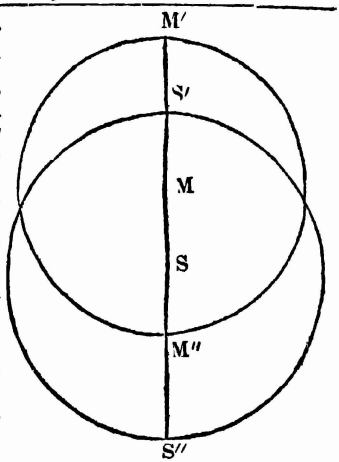
Sun's apparent radius = 16′ 2 7″
Moon's do. do. = 14′ 48·5″

$\sigma + p$ = 30′ 51·1″

$\sigma + p$ = 30′ 51·1″ = 1851·1″
S M = 233·3″

Part of the Sun's diameter eclipsed = 1617·8″

Sun's diameter = 1925·2″
1925·2″ : 1617·8 :: 1 : ·84
= part eclipsed.



At the beginning of the eclipse. $\sigma + p$ = 1854″ nearly; let M′ be the corresponding position of the moon.

$M M'^2 = S M'^2 - S M^2 = 3437316 - 54428\ 89.$
$= 3382887 \cdot 11$
$\therefore M M' = 1839''$

Apparent horary motion in N C = 1252·3″

Time from M′ to M $= \frac{1839}{1252 \cdot 3} = 1h.\ 28m.\ 7s.$

Time at M = $3h.\ 46m.\ 26 \cdot 27s.$

$\therefore$ Time of beginning = $2h.\ 18m.\ 19s.$ approximately.

At the end of the eclipse $\sigma + p$ = 1847″ nearly; let M″ be the corresponding position of the Moon.

M M″ = 1832 2″

Time from M to M″ $= \frac{1832 \cdot 2}{1252 \cdot 3} = 1h.\ 27m.\ 47s.$

$\therefore$ Time of end = $5h.\ 14m.\ 13s.$ approximately.

3d Division.

To find the times of beginning and end accurately.

In the second division of the calculations we supposed the path of the Moon to be a right line, (while it is a curve), during the whole time that the Eclipse lasts. The results cannot therefore be right. The apparent path of the Moon may be supposed to continue a right

line for the space of an hour, in the middle of the eclipse, without making any great error; and consequently the time of the middle, which we found, may be taken to be correct; but the approximate times of beginning and end have to be corrected. To do this we find the apparent places of the Sun and Moon at the approximate times of beginning and end, and also at two other times one very near the former and the other very near the latter, but upon different sides of the accurate times: and then by a rule of three we find the exact times of beginning and end.

Having found the time of beginning to be approximately 9*d*. 2*h*. 18*m*. 19*s*. Madras mean time, we shall find the apparent places of the Sun and Moon at this time.

Oct. 9*d*. 2*h*. 18*m*. 19*s*. M. MT. = Oct. 8*d*. 20*h*. 57*m*. 15·23*s* G.M.T.

12 35·55 = Equation of time.

2 30 50·55 = Madras true time.

Sun's AR. = 12*h*. 56*m*. 53·85*s*.

Hour ∠ from noon = 2 30 50·55.

AR. of mid-heaven = 15 27 44·4 = 231° 56′ 6″

Sun's long. = 195° 26′ 50″

Moon's long. = 195 22 37·1.

Moon's lat. = 30 50·7.

To find the height and longitude of the nonagesimal. Figure, &c. as in former cases.

$\amalg$ P Z = 38° 3′ 54″

θ = 50° 35′ 19″

$\amalg$ Z = 59° 13′ 52″

Height of nonagesimal = 59° 13′ 52″

P $\amalg$ Z = 135° 38′ 14″

Longitude of nonagesimal = 90° + 135° 38′ 14″

= 225° 38′ 14″

$\amalg$ Z = 59° 13′ 52″

$\amalg$ M = 89 29 9 3

Z $\amalg$ M = long. N.—long. of moon = 30°15′ 36·9″

θ = 85° 30′ 12″

Z M = 41° 41′ 43″

Madras horizontal $\|^x$ of the Moon $= 53' 54{\cdot}3''$
$= 3234{\cdot}3''$

$M M' = 36' 16{\cdot}7''$
$\prod M Z = 40° 36' 49''$
$\prod M' = 89° 56' 41{\cdot}8''$
$\prod M = 89° 29' 9{\cdot}4''$

$27' 32{\cdot}4'' =$ Moon's $\|^x$ in lat.
$= 1652{\cdot}4''$

Moon's $\|^x$ in long. $= 23' 36{\cdot}9'' = 1416{\cdot}9''$
Moon's apparent long. $= 194° 59' 0{\cdot}2''$
Moon's apparent lat. $= 3' 18{\cdot}2''$

$Z \prod S =$ long. N.—long. Sun $= 30° 11' 24''$
Sun's $\|^x$ in long. $= 3{\cdot}7''$
Sun's $\|^x$ in lat. $= 4{\cdot}4''$

Sun's apparent long. $= 195° 26' 46{\cdot}3''$
Sun's apparent lat. $= 4{\cdot}4''$ South.

Apparent difference of long. of Sun and Moon $= 27' 46{\cdot}1''$
$= 1666{\cdot}1''$
Do. do. of lat. of Sun and Moon $= 3' 22{\cdot}6''$
$= 202{\cdot}6''$

$\triangle$ of the Sun and Moon $= 1678{\cdot}4''$; where $\triangle$ is distance.

Moon's radius $= 14' 41{\cdot}5''$
Augmentation $= 10{\cdot}4''$

$p = 14' 51{\cdot}9''$

$\sigma = 16' 2{\cdot}6''$
$p = 14' 51{\cdot}9''$

$\sigma + p = 30' 54{\cdot}5'' = 1854{\cdot}5''$

But $\triangle$ of the Sun and Moon $= 1678{\cdot}4''$
$\therefore$ The eclipse has begun.

Since at $9d.\ 2h.\ 18m\ 19s.$ the eclipse has begun and since the difference between $\sigma + p$ and $\triangle$ is very small, let us find the apparent positions of the Sun and Moon at $2h.\ 6m.\ 19s.$ M. M. T. or $8d.\ 20h.\ 5m.\ 15{\cdot}23s.$ G. M. T.

$2h.\ 6m.\ 19s.$ M. M. T.
$12\ \ 31{\cdot}41$ = Equation of time.

$2\ \ 18\ \ 50{\cdot}41$ M.T.T.

Sun's A R. = $12h.\ 56m.\ 52{\cdot}02s.$
Hour $\angle$ from noon = $2\ \ 18\ \ 50{\cdot}41$

A R. of mid-heaven = $15\ \ 15\ \ 42{\cdot}43 = 228°\ 55'\ 36{\cdot}5''$

Sun's long. = $195°\ 26'\ 20{\cdot}3''$
Moon's long. = $195°\ 16'\ 43{\cdot}2''$
Moon's lat. = $30'\ 18\ 06''$

Υ P Z = $41°\ 4'\ 23{\cdot}5''$
Figure, &c. as in former cases.
θ = $49°\ 58'\ 39''$
Υ Z = $60°\ 5'\ 32''$
P Υ Z = $132°\ 23'\ 27''$
Long. of N. = $90° + 132°\ 23'\ 27'' = 222°\ 23'\ 27''$

Υ Z = $60°\ 5'\ 32''$
Υ M = $89°\ 29'\ 41\ 94''$
Z Υ M = long. N.—long. of Moon = $27°\ 6'\ 43{\cdot}8''$
θ = $85°\ 41'\ 3''$
Z M = $39°\ 6'\ 8''$
Moon's horizontal $\|^x$ for Madras = $53'\ 51\ 3'' = 3234\ 3''$
M M′ = $34'\ 24{\cdot}9''$
Υ M Z = $38°\ 47'\ 0{\cdot}8''$

Υ M′ = $89°\ 56'\ 31{\cdot}6''$
Υ M = $89°\ 29'\ 41{\cdot}94''$

$26'\ 49{\cdot}66''$ = Moon's $\|^x$ in lat.
= $1609{\cdot}66''$

Moon's $\|^x$ in long. = $21'\ 35{\cdot}5'' = 1293{\cdot}5''$
Moon's apparent long. = $194°\ 55'\ 9{\cdot}7''$
Moon's apparent lat. = $3'\ 28{\cdot}4''$

Z Υ S = long. N. — long. Sun = $26°\ 57'\ 6{\cdot}7'$
Sun's $\|^x$ in long. = $3{\cdot}4''$
Sun's $\|^x$ in lat. = $4{\cdot}3''$

Sun's apparent long. = 195° 26′ 16·9″
Sun's apparent lat. = 4 3″ South.

Apparent difference of long. of Sun and Moon = 31′ 7·2″
= 1867·2″
Apparent difference of lat. of Sun and Moon = 3′ 32·7″
212·7″

$\triangle^2 = \overline{1867{\cdot}2}^2 + \overline{212{\cdot}7}^2$; where $\triangle$ is the distance between the Sun and Moon.

$\triangle = 1879{\cdot}2''$

Moon's radius = 14′ 41·5″
Augmentation = 10·7

p = 14 52·2

σ = 16′ 2·6″
p = 14 52·2

$\sigma + p$ = 30 54·8 = 1854·8″

∴ The Eclipse has not begun.

At 2*h*. 6*m*. 19*s*. $\triangle$ = 1879·2′
At 2 18 19 $\triangle$ = 1678 4

∴ in 12*m*. the Sun and Moon approach by 200·8″
And at 2*h*. 6*m*. 19*s*., the discs are 24·4″ apart.

200·8 : 24·4 : : 12*m*.: 1*m*. 27·5*s*. = time from 2*h*. 6*m*. 19*s*. to moment of appulse.

Time of beginning = 2*h*. 7*m*. 46·5*s*.

To find the termination of the Eclipse accurately.

Having found the time of the end to be approximately 9*d*. 5*h*. 14*m*. Madras M. T. we shall now find the apparent places of the Sun and Moon at this time.

9*d*. 5*h*. 14*m*. M. M. T. = 8*d*. 23*h*. 52*m*. 56·23*s*. G. M. T.
12*m*. 33·55*s*. = Equation of time.

9*h*. 5*m*. 26 33·55*s*. M. T. T.

Sun's AR = 12*h*. 57*m*. 20·76*s*.
Hour ∠ from noon = 5 26 33·55

AR of mid-heaven = 18 23 54·31 = 275° 58′ 34·7″

Sun's long. =195° 34′ 3·8″
Moon's long. =196 48 57·9
Moon's lat. = 38 47·94

P Z = 77° 0′ 36″
P ♈ = 23 27 24
♈ P Z = 5 58 34·7

Figure, &c. as in former cases.

θ = 53° 49′ 43″
♈ Z = 53 42 12
Height of Nonagesimal = 53° 42′ 12″
P ♈ Z = 172° 46′ 7″
Long. N = 360° + 90°—P ♈ Z = 277° 13′ 53″

Figure, &c. as in former cases.

θ = 77° 25′ 19″
Z M = 81 54 5
Moon's horizontal ||ˣ for Madras = 53′ 54·7″=3234·7″
M M′=3209·1″
♈ M Z =53° 23′ 25″

To find ♈ M′

Formula as in former cases.

M M′=3209·1″=53′ 29·1″
∴ ♈ M′=89° 53′ 6·1′
♈ M =89 21 12·1

31 54·0= 1914″=Moon's ||ˣ in lat.

Moon's ||ˣ in long. =42′ 56″ = 2576″
Moon's apparent long. = 196° 6′ 1·9″
Moon's apparent lat. = 6 53·9

To find the Sun's ||ˢᵉᶜ in lat. and long.

Figure and formula as in former cases.

Z ♈ S = long. N — long. Sun = 81° 39′ 49·2″
6·9″ = Sun's ||ˣ in long.
5·1 = Sun's ||ˣ in lat.
Sun's apparent long. = 195° 33′ 56·9″
Sun's apparent lat. = 5·1 South.

Apparent difference of long. of Sun and Moon = 32′ 5″
= 1925″

Apparent difference of lat. of Sun and Moon = 6′ 59″
= 419″

Sun's radius = 16′ 2·6″ = 962·6″ = σ
Moon's radius = 14′ 41·6″
Augmentation = 1·8
p = 14′ 43·4″ = 883·4″
$\sigma + p$ = 1846″

$\overline{\text{dif. lat.}}^2 + \overline{\text{dif. long.}}^2 = \Delta^2$

$\therefore \Delta = 1970''$; but $\sigma + p = 1846''$

$\therefore$ The eclipse has ended.

Since at 9*d*. 5*h*. 14*m*. the eclipse has ended and since the difference between σ + P & Δ is very small we shall find the apparent positions of the sun and moon at a time less than the former by 12 minutes or at 9*d*. 5*h*. 2*m*. M. M. T.

9*d*. 5*h*. 2*m*. M. M. T. = 8*d*. 23*h*. 40*m*. 56·23*s*. G. M. T.
12 33· 41 = Equation of time.
9 5 14 33· 41 = M. T. T.

Sun's AR = 12*h*. 57*m*. 18·92*s*.
Hour $\angle$ from noon = 5*h*. 14*m*. 33·41*s*.
AR of mid-heaven = 18 11 52·33 = 272° 58′ 5″

Sun's long. = 195° 33′ 34·1″
Moon's long. = 196 43 4
Moon's lat. = 38 15·3
P Z = 77° 0′ 36″
P ♈ = 23 27 24
♈ P Z = 2 58 5

Figure and formula as in former cases.

θ = 53° 53′ 5″
♈ Z = 53 35 25 = height of Nonagesimal.
P ♈ Z = 180° — 3° 35′ 40″ = 176° 24′ 20″
Long. N = 360° + 90° — 176° 24′ 20 = 273° 35′ 40″

♈ Z = 53° 35′ 25
♈ M = 89 21 14 7

M ∏ Z = 76 52 36

Figure and formula as in former cases.

θ = 79° 14′ 7″

M Z = 79 5 10

Moon's horizontal ||ˣ for Madras = 53′ 54·7″
= 3234·7

∴ M M′ = 3185·2″ = 53′ 5·2″

∏ M Z = 52° 57′ 35″

Formula as in the former cases.

∏ M′ = 89° 53′ 43·4″

∏ M = 89 21 44·7

31 58·7 = Moon's ||ˣ in lat.
= 1918·7″

Formula as in former cases.

Moon's ||ˣ in long. = 42′ 22·4″ = 2542·4″

Moon's apparent long. = 196° 0′ 41·6″

Moon's apparent lat. = 6 16·6

Figure and formula as in former cases.

6·8″ = Sun's ||ˣ in long.

5·1 = Sun's ||ˣ in lat.

Sun's apparent long. = 195° 33′ 27·3″

Sun's apparent lat. = 5·1 South.

Apparent difference of lat. of the Sun and Moon = 6′ 21·7″
= 381·7″

Do. do. of long. of the Sun and Moon = 27′ 14·3″
= 1634·3″

14′ 41·6″ = Moon's radius.

2·6 = Augmentation.

14′ 44·2″ = p = 884·2″

σ = 16 2·6 = 962·6

p = 14 44·2 = 884·2

$\sigma + p$ = 30 46·8 = 1846·8

$\overline{\text{dif. lat.}}^2 + \overline{\text{dif. long.}}^2 = \triangle^2$

$\triangle^2 = \overline{381·7}^2 + \overline{1634·3}^2$

$\triangle$ = 1678·3″; but $\sigma + p$ = 1846·8″

$\therefore$ The Eclipse has not ended.

$\sigma + p = 1846{\cdot}8''$
$\Delta = 1678{\cdot}3$

$168{\cdot}5$ = space through which the Moon has to move to end the eclipse.

$1970''$ = distance of the Sun and Moon at the 1st time.
$1678{\cdot}3$ = do. do. do. at the 2d time.

$291{\cdot}7$ = space through which the Moon moves in $12m.$

$291{\cdot}7 : 168{\cdot}5 :: 12m. : 6m.\ 56s.$ = time that the Moon takes to move through $168\ 5''$.

$\therefore$ Time of end = $9d.\ 5h.\ 2m. + 6m.\ 56s. = 9d.\ 5h.\ 8m.\ 56s.$

V. Ramanoojiah.

18*th September*, 1847.

Reports of the Government Translators.

Tamil.

I examined the Students of the Madras High School on the 13th Ultimo, in Tamil.

I have now finished the review of the written exercises.

T. Vencata Charry
C. Runga Charry.
P. Runganadum.
D. Sashiah
P. Vizia Rungum.
M. Seevagooroo.
V. Ruthnum.
P. Soondrum.
V. Streenevassa.
T. Rajah Ram.

The Students whose names are in the margin, executed the Papers of the 1st degree of difficulty.

T. Vencata Charry is decidedly the best Tamil scholar. His translations, especially that from English into Tamil, are exceedingly well done. In vivâ voce he was also very successful.

The other nine students have also done well, although they are inferior to T. Vencata Charry.

Of those who executed the Papers of the 2d degree of difficulty, I am of opinion that C. Cothundaram is entitled to the first place in the order of merit. His translations are very respectable performances.

The remaining youths of the 3d, 4th, and 5th classes were examined only vivâ voce. Of them, I consider that C. Cunnyen of the 3d class, A. Iyasamy of the 4th class, and M. Satoor of the 5th class, are respectively entitled to the place of precedence above their fellows.

I think it right, however, to submit my opinion that the result of the late examination is in my judgment generally satisfactory.

I may perhaps be permitted to suggest—with reference to future proceedings, that the time allowed for examination is hardly sufficient, in respect of the vivâ voce part, to enable the Examiner to arrive at a very accurate conclusion as to the relative merits of the Students.

T. H. Davidson,
Tamil Translator to Government.

Madras,
May 4th, 1848.

Telugoo.

Report regarding the Telugoo Examination held at the High School in April, 1848.

Arrangement according to merit.

First Rank.

1. W. Sashachellum.
2. G. Rajahgopaul.
3. N. Parthasarady.

Second Rank.

1. Balakristnasawmy.
2. S. Soondrum.
3. A. Narrain Row.
4. C. Balakristniah.

Third Rank.

1. W. Govindoo.
2. W. Sashiah.
3. T. Saccajee Row.

The above have all been examined in reading and in writing Telugoo, which is their Native language. They have written translations from and into English.

None of them are faultless in Telugoo orthography: but the three who stand first have translated from English into Telugoo and vice versâ, in a style that does them great credit. Their handwriting is excellent.

There remain

P. Vencatakistnamma.
C. Parthasardy Chitty.
A. Naganah.
P. Ramanjulu.

who are in the first and second classes, but proved unable to translate.

And the third class, ten in number, with the 4th class, fourteen in number, have failed to read in such a manner as to call for classification.

The result of this examination is not very satisfactory. I do not blame the pupils, but the tutor. In the examination held a year ago I pointed out the defects of the system, showing that useful knowledge is neglected, and the boys are laboriously taught much that is entirely useless. They are instructed in much that looks learned and poetical: while they remain (as was again proved on this occasion) unable to read common letters, or understand common accounts written in their Native tongue.

The fourth class, I think, ought to be broken up, as the boys in it are mere idlers.

MADRAS, 26*th April*, 1848.

C. P. BROWN,
Telugoo Translator to Government.

I was directed to examine in Hindustani likewise; but found there were no pupils to be tried.

C. P. BROWN,
Persian Translator to Government.

Mahratta.

From

Major CRISP,

Mahratta Translator to Government.

To

S. CRAWFORD, ESQ.,

Secretary to the Madras University.

SIR,

I have the honor to report my completion, on Monday last, of the examination of the Mahratta Students of the University High School; and to state for the satisfaction of the Governors, that the several classes acquitted themselves very creditably.

In the roll of comparative proficiency which accompanies this letter, a double cross is affixed to the names of the most meritorious and distinguished.

The senior class especially underwent a severe test under my own eye, in having to translate, off-hand and without help, a paragraph of Mahratta History into English; and again, a portion of English Oriental History into Mahratta. The execution of these tasks by the three seniors is particularly commendable, and exhibits the great forward progress which has been made in the sound inculcation of the two languages.

In general attainment and ability, the youths stand as marked in the roll. But I must draw particular attention to the superior quality of Ragoonath Row's exercises, as being freer from errors and misapprehensions of construction and sense than those of his longer trained class-fellows, Ramachunder Row and Baboo Row. Ramachundra stands first in general proficiency.

The vast stride which has been made in maturing the knowledge of Mahratta, is particularly manifest to me perhaps too strikingly apparent, from my having been absent from the Presidency on the occasion of the two last annual examinations—but the obvious inference is, that a course of instruction which has produced such effects, must be based upon sound principles, and reflects great credit upon Gunnish Sastree, the able and zealous teacher of the Mahratta classes.

I have the honor to be,
Sir,
Your most obedient Servant,
J. CRISP, Major,
Mahratta Translator to Government.

FORT ST. GEORGE,
4th May, 1848.

Abstract Account of the actual Disbursements of the Madras University, during the first six months of the official year 1847-48, *or from* 1*st May to* 31*st October*, 1847.

1847.		Rs.	A.	P.	Rs.	A.	P.
	HIGH SCHOOL.						
	Amount paid the Establishment, including the Secretary's Department and Government Scholarships, from 1st May, to 31st October, 1847, - - - - - -	13,946	8	9			
	House-rent from do. to do.	1,260	0	0			
					15,206	8	9
	CONTINGENT CHARGES.						
	Books and Book-binding, - -	793	4	10			
	Furniture, - - - - - - -	24	4	0			
	Printing, - - - - - -	418	7	10			
	Stationery, - - - - - - -	126	0	0			
	Sundries, - - - - - - -	878	0	5			
	Pacheappah'sEndowed Scholarships,	529	5	4			
	Elphinstone's do. Scholarship,	72	0	0			
					2,841	6	5
					18,047	15	2
	DEDUCT.						
	School-fees realized during the above period, - - - - - -	2,194	6	4			
	Amount realized for Books lost by Scholars, - - - - - -	32	6	0			
	Amount deducted from the Salary of the 2d Master, - - -	500	0	0			
	Do. do. from the Mahratta Master,	105	0	0			
	Balance remaining in favor of Pacheappah's Trustees, - - -	2,429	13	2			
					5,261	9	6
	Net amount of Expenditure, - -	. . .	. .	. .	12,786	5	8

MADRAS UNIVERSITY,
27th November, 1847.

Abstract showing the Advances received from Government on account of the Madras University, from 1st May to 31st October, 1847, the actual Disbursements during the same period, and the Balance of Cash remaining on the 31st October, 1847.

1847.		Rs.	A.	P.	Rs.	A.	P.
	Balance of Cash on the 30th April, 1847, appropriable to the Disbursements of the year, - -	5,200	5	5			
	Amount of advance received under orders of Government dated 27th June, 1847, - - - - -	10,000	0	0			
					15,200	5	5
	DEDUCT.						
	Disbursements as per Abstract Account from 1st May, to 31st October, 1847, - - - - -	.....	..	..	12,786	5	8
	Balance of Cash on 31st October, 1847, appropriable to future Disbursements, - - - - -	.....	..	..	2,413	15	9

Errors Excepted,

S. CRAWFORD,
Secretary.

Abstract Account of the Actual Disbursements of the Madras University, during the last six months of the official year, 1847-48, *or from 1st November*, 1847, *to 30th April*, 1848.

1847-48.		Rs.	A.	P.	Rs.	A.	P.
	HIGH SCHOOL.						
	Amount paid the Establishment, including the Secretary's Department and Government Scholarships, from 1st November, 1847, to 30th April, 1848, - - -	13,709	4	8			
	House-rent, from do. to do. -	1,260	0	0			
					14,969	4	8
	CONTINGENT CHARGES.						
	Books and Book-binding, - -	742	7	7			
	Furniture, - - - - - -	31	8	0			
	Printing, - - - - - -	26	3	0			
	Stationery, - - - - -	327	9	5			
	Sundries, - - - - - -	293	12	4			
	Pacheappah's Endowed Scholarships,	540	0	0			
	Elphinstone's do. Scholarship,	72	0	0			
					2,033	8	4
					17,002	13	0
	DEDUCT.						
	School-fees realized during the above period, - - - - - -	2,386	0	0			
	Amount realized for Books lost by Scholars, - - - - - -	19	6	0			
	Amount of Interest realized at different periods on Elphinstone Endowment Bonds in the Madras Bank, - - - - - -	557	2	6			
	Refunded from an advance for Sundries, - - - - - -	3	2	6			
	Amount realized for an old Clock, sold by auction, - - - -	41	6	5			
	Balance remaining in favor of Pacheappah's Trustees, - -	3,585	13	2			
					6,592	14	7
	Net Amount of Expenditure, - -	.....	..	..	10,409	14	5

MADRAS UNIVERSITY,
1st July, 1848.

Abstract showing the Advances received from Government, on account of the Madras University, from 1st November, 1847, to 30th April, 1848; the actual Disbursements during the same period, and the Balance of Cash remaining on 30th April, 1848.

1847-48.		Rs.	A.	P.	Rs.	A.	P.
	Balance of Cash on the 31st October, 1847, appropriable to the disbursements of the year, - -	2,413	15	9			
	Amount of Advance received under orders of Government, dated 2d December, 1847, - - -	10,000	0	0			
	Do. do. do. dated 25th April, 1848,	10,000	0	0			
					22,413	15	9
	DEDUCT.						
	Disbursements as per Abstract Account from 1st November, 1847, to 30th April, 1848, - - - - -	.....	..	..	10,409	14	5
	Balance of Cash on 30th April, 1848, appropriable to future Disbursements, - - - - - -	.....	..	..	12,004	1	4

Errors Excepted,

S. CRAWFORD,
Secretary.